RENEWABLE RESOURCES AND THE ECONOMY OF THE NORTH

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First International Symposium on Renewable Resources and the Economy of the North

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Milton M.R. Freeman *(editor)*

Association of Canadian Universities for Northern Studies

Canada Man and the Biosphere Program

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Table of Contents

Introduction v

Acknowledgements vi

Keynote Papers

Comments on the realities and conflicts of ecosystems, economic systems and cultural expression in the northern environment 1

E.F. Roots, Environment Canada, Ottawa, Ontario

Fish, fur and game in the Northwest Territories: some problems of, and prospects for, increased harvest 12

W.A. Fuller, University of Alberta, Edmonton, Alberta, and B.A. Hubert, Science Advisory Board of the Northwest Territories, Yellowknife, N.W.T.

Managing non-native renewable resource use in the North: rising expectations in unproductive ecosystems 30

G.F. Hartman, Fisheries and Oceans Canada, Nanaimo, B.C.

Sustenance or recreation? The future of native wildlife harvesting in northern Canada 56

Peter J. Usher, P.J. Usher Consulting Services, Ottawa, Ontario

Some thoughts towards a policy for the rational use of renewable resources in the Canadian north 72

Paul F. Wilkinson, McGill University, Montreal, Quebec

Special Address

The reindeer industry in the western Canadian arctic: problems and potential 86

William Nasogaluak, Canadian Reindeer Ltd., Tuktoyaktuk, N.W.T., and Douglas Billingsley, Inuvik, N.W.T.

Discussion following the Special Address 91

Circumpolar Country Reports

The Alaska Eskimo Whaling Commission and its response to the challenge of renewable resources and the economy of the north 96

Richard A. Nevé, University of Alaska, Fairbanks, Alaska

Natural resources and human activity in northern Finland in post-war times 99

Eino Siuruainen, University of Oulu, Oulu, Finland

Exploitation and conservation of living resources in the Norwegian arctic 118

Magnar Norderhaug, Ministry of Environment, Oslo, Norway

Land Use — North: research on land use conflicts in northern Sweden 131

Kurt V. Abrahamsson, University of Umea, Umea, Sweden

Renewable resources of north-east Siberia 133

I.E. Bogdanov, Institute of Biological Problems of the North, Magadan, U.S.S.R.

Biological and medical investigations in the Soviet subarctic: some social and economic aspects 137

G.P. Krasnoshchekov, Institute of Biological Problems of the North, Magadan, U.S.S.R.

Contributed Papers

Fisheries of the James Bay area and northern Quebec: a case study in resource management 143

Fikret Berkes, Brock University, St. Catherines, Ontario

Is there potential for Canadian northern agriculture? A justification for research on northern native plants as potential foodcrops 161

M.J. Romer, W.R. Cummins and J. Svoboda, Erindale College, University of Toronto, Mississauga, Ontario

The role of self-regulation in living resources management in the North 166

Fikret Berkes, Brock University, St. Catherines, Ontario

Gathering and governing: renewable resources and the economy of the North 179

J.E. Chamberlin, University College, University of Toronto, Toronto, Ontario

The Canadian High North: resource of renewal 183

Josef Svoboda, Erindale College, University of Toronto, Mississauga, Ontario

Northern renewable resource management: socio-psychological dimensions of participation 190

Frank J. Tester, University of Calgary, Calgary, Alberta

The time for token Eskimos and second-hand information has passed: some thoughts on the problems of communication between the scientific management sector and Inuit users of renewable resources in the North 198

Marianne Stenbaek-Lafon, McGill University, Montreal, Quebec

Impacts of industrial employment on hunting and trapping among Canadian Inuit 202

Charles W. Hobart, University of Alberta, Edmonton, Alberta

Workshop Reports

Caribou management 219

Chairman: V. Geist, University of Calgary, Calgary, Alberta

Co-operative research 221

Chairman: Martin Lewis, York University, Downsview, Ontario

Expanding the supply of renewable resources 226

Chairman: W.W. Mair, Victoria, B.C.

Planning for the future: management 229

Chairman: John K. Naysmith, Northern Pipeline Agency, Calgary, Alberta

Planning for the future: research 233

Chairman: H.A. Regier, University of Toronto, Toronto, Ontario

Proposed international networks for co-operation in northern science 239

Chairmen: J.M. Harrison and Edith Carter, Canada Man and the Biosphere Program, Ottawa, Ontario

Closing Address

Can we talk our way into a better northern resource management and economy? 249

E.F. Roots, Environment Canada, Ottawa, Ontario

Appendices

Ethical principles for the conduct of research in the North 260

Association of Canadian Universities for Northern Studies Draft Document 1981 (based upon Canada Man and Biosphere Discussion Document, 1977).

List of Symposium Participants 263

INTRODUCTION

Despite the various changes occurring in the Arctic and subarctic regions as industrial and commercial activities move northward and intensify, renewable resources continue to be important to people living in these regions. However, as only a small part of the local renewable resource harvest actually enters the market economy, these resources and associated activities are generally and seriously under-represented in assessments of the regional economy. This causes the overwhelming focus of northern development planning in Canada to rest upon large-scale, capital-intensive, non-renewable resource projects, despite the fact that today, as in the past, considerable economic and social value resides in the continuing utilization of traditionally-important local resources.

It is for these reasons that concern continues to be expressed by government and many northern residents in favour of a more balanced approach to resource and social development in the Canadian North, wherein compatible exploitation of various renewable and non-renewable resources jointly contribute to local, regional and national development goals.

The Banff Symposium was planned to direct attention of research scientists and policy planners both to recent advances and to problems that exist in the fields of northern renewable resources management and utilization. The problems addressed were not exclusively Canadian, and therefore the Symposium invited contributions from other members of the circumpolar community. The main focus however, as defined in five keynote papers on the opening day of the Symposium, was directed toward identification and discussion of problems germane to the Canadian North. These five papers embraced the main themes of the Symposium, namely, issues relating to the role and management of renewable resources to other aspects of northern development, the biological characteristics and potential of renewable resources important in the regional economy, the nature of the demands placed on these resources by non-native and native users of the resources, and policy approaches to renewable resource management.

The Symposium opened with welcoming addresses from J.G. Nelson (President, Association of Canadian Universities for Northern Studies), J.M. Harrison (Chairman, Canadian Man and the Biosphere Program), M.J. Dunbar (International Union for the Conservation of Nature and Natural Resources), and F. di Castri (United Nations Educational, Scientific and Cultural Organization). The five keynote papers were then delivered and following these, participants from each of the circumpolar countries represented at the Symposium reported on relevant management and/or northern research programs, current or planned in their own countries.

An important feature of the Symposium was the series of workshops at which scientists, managers, resource users, and policy directors held discussions over a two-day period.

The Symposium proceedings include the keynote papers, the international reports, and reports from the workshops. Also included are a series of papers contributed by several participants. The reader will note a number of contradictory opinions expressed in these different reports, which reflect, more especially, the different perspectives and methodological approaches of the different interest groups represented at the Symposium. However, much common ground exists, and the Symposium demonstrated that despite differing viewpoints and intensity of debate, fruitful discussion can be held and mutual

understanding and advances achieved. In each case opinions expressed reflect the personal views of the authors, or chairmen/rapporteurs' reports of discussions held in workshops. They do not represent an official position of or endorsement by the Symposium sponsors.

These proceedings are published to add to public awareness of facts, issues and needs relative to the rational management of northern resources, as well as to suggest new goals and provide impetus to Canadian scientists active in northern research. In addition, it is hoped that the Symposium itself, as well as the published record of the meeting, will contribute to interaction among northern researchers in different circumpolar countries and disciplines, among concerned Canadians in different sectors of society, and in particular, to encourage better quality discourse between research scientists on the one hand, and residents of northern Canada on the other hand.

Acknowledgements

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The Symposium Chairman wishes to acknowlege his especial indebtedness to his colleagues on the Organizing Committee, Edith Carter, Eileen van Heyst and Cam Mackie, and to Jim Harrison, Chairman, Canadian MAB Program, and John Stager, then-President, ACUNS, for support throughout.

Ottawa, August 1981

Milton M.R. Freeman
Symposium Chairman

1

2

3

4

5

6

7

8

9

10

11

12

13

1. L-R: J.M. Harris, F. di Castri 2. L-R: J.K. Naysmith, S. Kakfwi 3. L-R: S. Ekoomiak, P. Ernerk 4. M. Norderhaug 5. L-R: W. Nasogaluak, D. Billingsley 6. L-R: G.P. Krasnoshchekov, P. Poole, J. Jacquot 7. Foreground, L-R: P. Ittinuar, P. Kritaqliluk; Background, L-R: J.K. Naysmith, A. Herridge 8. H.A. Regier 9. R. Lamothe 10. E. Siuruainen 11. P.C. Mackie 12. L-R: P. Kritaqliluk, G.P. Krasnoshchekov, P. Poole 13. P. Kritaqliluk

14

15

16

17

18

19

20

21

22

23

24

14. J. Agma 15. L-R: I.E. Bogdanov, O. Schaefer, G.P. Krasnoshchekov 16. W.W. Mair 17. M.M.R. Freeman 18. M. Kusugak 19. H. Brody 20. L. Brooke 21. L-R: I.E. Bogdanov, G. Calef, K. Taylor (Standing), V. Geist 22. M.C. Lewis 23. P.F. Wilkinson 24. Left Background: A. Herridge; Centre background: P. Poole; Foreground, L-R: J. Agma, P. Ittinuar, P. Kritaqliluk, P. Ernerk, M.M.R. Freeman

THE NORTHERN DILEMMA: Comments on Realities and Conflicts of Ecosystems, Economic Systems and Cultural Expression in the Northern Environment

E. F. Roots
Environment Canada, Ottawa, Ontario

What are we here for?

As our welcoming speakers have noted, and as the literautre sent to each of us to invite us here has described, the purposes of this symposium are to examine the problems and opportunities for management of the renewable resources of northern regions; and to explore the part that such resources play in the overall economy of northern regions with a view toward improving or safeguarding the contribution they can make to economic and social well-being.

There have, as you know, been many, many conferences on northern resources — in fact I have just come from one last week on the development and management of non-renewable resources in our frontier regions—; and goodness knows there seems to be no end to workshops, studies, committees and policy meetings on the economy of northern areas and how to improve it or develop it. So what can this symposium do? The statement of purpose makes the very telling point that because only a small part of the renewable resource harvest in northern regions enters the market economy, the true importance of renewable resources is consistently under-estimated in most assessments of the regional economy, which are usually expressed in market terms. Development planning and policy attention is normally concentrated on capital-intensive, market-oriented industrial projects. By the same token, it is implied, policies, investments, and political goals for social development in the north become focussed around monetary and wage employment assessments and trends, which by their nature cannot account for the full role that is in fact played by renewable resources or activities connected with them. As a result of these distortions, not only is responsibile utilization and management of renewable resources very difficult to achieve, but effective social and economic development as a whole is handicapped because an important element is not properly taken into account. By examining these problems through this symposium, it is hoped that a "more balanced approach to economic and social development" can be indentified, that the public awareness of "facts, issues and needs relative to rational resource management" can be increased, and "better quality discourse among researchers and between researchers and northern residents" can be encouraged.

Those are a lot of high-sounding words. They sound rather as if we might have three days of academic discourse on the theories and problems of economic accounting and management of multi-mode non-quantifiable assets within a polymorphous societal response structure. I sincerely hope that this not what we are going to do. As I see it, most of us are here because of some blunt facts. I will mention six. Any of us here could add to the list, of course:

1. Large industrial enterprises are pushing into parts of the north with machines, men and money because by so doing they can make money in the south;

2. The new developments pose a risk of interfering with local biological systems and of so damaging the land, the streams and the shorelines, and perhaps even the oceans, that the biological productive capacity of many regions, already low, could be severely and even permanently reduced;

3. Even without the stress of these new large-scale developments, increasing local human populations and an increasing trend toward concentration in settlements, transition to a cash economy and use of advanced technology has badly taxed the supply of game and fur animals, has led to less efficient use of the harvest that is taken, and created social and inter-community conflict even though the material dependence on "country living" is less;

4. Government policies to encourage the industrial invasion of the north by southern interests, which bring with them southern objectives, and southern managerial practices and accounting systems, are at least in practice often at cross-purposes with government policies concerned with the rights and social development of northern residents, the long-term quality of its environment, and the use and management of its indigenous renewable resources. And whenever these two kinds of policies meet or overlap, those encouraging industrialization or rapid commercial development seem to take precedence;

5. Social development, southern-style education, and influx of people who bring a recreational or competitive approach to the use of wildlife and of the land — plus sheer numbers of people — are causing disintegration of established patterns of deliberate or inherent feelings of stewardship for the land amd are making it very difficult for even the most traditional residents to maintain their sense of identity with the land and its non-human inhabitants. This loss of feeling of identity is only slowly being replaced by a compensatory desire for and acceptance of management policies or regulations designed to ensure fairness of use and long-term maintenance of the resource;

6. Research and study of northern questions, and especially northern resource questions has not, as seen in the eyes of local residents and their communities, been helpful to their problems; in fact their problems have grown worse during the period that the researches have been undertaken. Thus the credibility of the scientists and their studies is not very high in many parts of the north. At the other end of the power scale, science has not shown itself to be directly relevant or essential to political decisions about the north, so governments have seen little need to support northern research in more than token fashion.

These are some of the kinds of problems that I think we will want to talk about this week. They are the facts of life in the north in the 1980's. They pose problems that seem to many to have reached crisis proportions, because environmental and resource realities clearly make some of the legitimate economic or life-style goals unrealistic, and because cultural, economic and political realities have made quite legitimate interests come to be at cross-purposes with one another without providing, as yet, a satisfactory means of bridging or resolving the differences.

The social, institutional and financial ecosystem of the north, like the biological ecosystem, is a low-energy system, highly stressed and vulnerable to rather rapid changes caused by external influences — sometimes without recovery. This situation poses a dilemma for communities, governments, and corporations alike, and for local associations and institutions; there is not enough momentum or energy in the system of policies and responses for a disturbance to be balanced out or for instabilities to be self-correcting. Because economic influences are mostly external, and because policies and social responses are becoming increasingly unstable, doing nothing seems to mean letting matters grow worse; but most attempts at control or direction that have been tried so far also seem to have made matters worse, and seem even to have led to the present situation. Our workshop can perhaps take a careful look at this apparent Catch-22 situation, examine to what extent it is real, and maybe find some way that we might break out of the dilemma. Our way into the subject will be through an examination of the role of renewable resouces in the larger economy of the north, for this question is central to the development of social aspirations and responsibilities, is intimately tied to the effects of industrial development and the policies that govern it, and on our concept of renewable resources and policies for their management may hang the whole future character of the northern regions and their people.

What do we Mean?

Our approach to the kinds of problems we have just listed is critically dependent on the perceptions we bring to the issues. As the first speaker at this symposium, it is almost obligatory that I should define my terms, so that you know what I mean when I talk about resources, economy, or management. But immediately I have a problem, which leads directly to the dilemma that pervades all the major issues of the north today. No matter what words I use to define my own meanings, different people in this audience, and different groups of people in the north and the south, will receive different ideas about what I am trying to say. This problem of communication, of different perceptions and meanings arising from the same words or ideas, is of course, universal; but it is particularly acute in northern Canada today. The problem is not only one of words or language — it is a problem equally true of the interpretation put on actions, or feelings. Think, for a moment, what different meanings are attached not only to the words, but to the actions and intentions, connected with the idea "development of the north" by different groups who live in the north and different groups who live in the south. Or try, with the best will in the world and genuine sympathy on both sides, to find a way of relating the value placed on the land by a native northerner to the concept of "land values" as understood by those dealing with property, policies or commerce.

These differences of perception have much to do with the difficulty we are encountering in trying to solve many of the problems in the north today. The problems are real enough:

— how to find the oil and get it out at a profit without damaging the environment;

— how to raise the material standard of living of northern people without making them dependent on welfare;

— how to preserve and enhance stocks of wildlife in the face of restricted productivity of habitat and increasing hunting capacity from larger numbers of people;

— how to provide the education that will allow northerners to participate in the business

and political institutions of their own country without at the same time destroying the very traditions and values that are most important to them and in the long run, very important to Canada.

We could spend the next three days listing such problems. These problems are all solvable — a solution of one sort or another is inevitable. The solutions may not be to our liking. But to find the solutions that are best for the future of northern Canada and for the country as a whole, and then to achieve them is made particularly difficult by the strongly different perceptions that are associated with the same ideas by the different groups concerned with northern Canada. The differences in approach and assumption between the newcomers and the old-timers, between industry leaders and leaders of indigenous people, between government people and everybody else, and the breadth of the generation gap among northern residents of all backgrounds makes southern Canada, with all its problems, look homogeneous by comparison. What is surprising to me, as both participant and observer, is that these differences in perception seem to have arisen between groups who often share similar economic and social goals. In fact, it sometimes seems to me that one of the important distinctions between northern and southern Canada may be that in southern Canada various elements of society often differ quite widely in their goals and objectives, but tend to have fairly common perceptions — that is, in the south we get about the same meanings out of our information systems, even if we don't all agree with what we get —; while different groups in the north often have the same general goals to a surprising degree, but yet get quite different signals from the same information. We must quickly point out that one perception is not necessarily more accurate than the others. All may have the same facts, and may understand them adequately but the importance given to the facts, and the insights and interpretation of their significance, may be quite different between one group of people and another. These differences often seem to be greater with regard to issues in northern Canada than they are commonly in the south.

I think that a case could be made that in this respect there is a difference between northern Canada and Alaska, which may in part account for the different course of events in each country. In Alaska, it seems to me, almost all groups, from native organizations to pipeline corporations, have managed to develop more or less the same lines of perception about what is happening, although there may be strong differences in objectives, and strong disagreement on how to reach the objectives or how to apportion the benefits and costs. Thus there is some common basis from which to negotiate, and it is not too difficult to reach agreement on the mechanism for negotiation. Disputes regarding resources in Alaska thus commonly become questions of allocation of benefits from resource development, ownership of wealth, and recognition of authority; and adjustments proceed through the courts, through announcement of government policies, by political referendum, and through economic settlements. In Canada, by contrast (I do not want to make too much of this), because basic perceptions are not shared to the same extent, there tends to be little common ground, and the mechanisms for negotiation are much harder to identify and agree upon. As a result, attempts to use southern-style institutions such as the courts or legislation or the award of cash settlements to solve problems often seem only to increase the injustices, no matter how legally correct and generous the settlement may be.

Cultures — Linked, Merged, or Swamped?

If Clifford Geertz is correct in stating that the essence of culture is a *sharing of meanings*, and not the trappings of a society or possession of a common history or ritualistic

behaviour, then part of our problem may be that we are seeing in northern Canada not so much a conflict between an existing locally-based culture and an invading commercial and political culture, but the rapid evolution of a number of genuinely distinct cultures, different from both the traditional indigenous cultures and the pervasive technico-economic culture of the south. Central to these distinctive shared meanings or cultures, expressed best by articulate and sophisticated northern residents, is the importance of the management of renewable resouces, not only to the economy but to freedom, rights, and the exercise of authority.

To the extent that this is true, and while it lasts, we should not expect a gradual absorption of the needs and desires of the north into those of the south, or a merging of distinct value systems. We can build linkages between different cultures, but we should not, perhaps, search fruitlessly for common grounds for negotiation. We will have to try to find ways of accommodating quite different sets of values and societal approaches within the same sets of resource constraints and administrative possibilities. The way that we do this has enormous significance for renewable resources and the economy of the north.

The dominant culture has a choice — it can state its meanings as clearly as it can and try to help others to understand its perceptions, knowing they will have to live under them anyway; *or*, it can agree to make accommodations to quite other sets of perceptions and values that it does not share or fully understand. The less dominant cultures have no such choice: they must co-exist with systems and decisions they do not necessarily share or participate in, though they can try to influence them. For if such cultures adapt to the imposed set of values and begin to share the perceptions of the others, they cease to exist as separate cultures. It is the genuine fear of losing a shared fundamental sense of values, and thus a vital base of cultural identity, over issues which other groups see basically in terms of economy, resource management and conservation, but not of identity, that gives northern resource questions aspects of intractibility and sometimes desperation.

Renewable biological resources themselves tend to become the pawns in this game. Disputes over their management become part of the strategy, used to win a point; and, if all sides are not very careful, the resources may be sacrificed in the process.

Resources and Economy

"Resources" are defined by the Oxford dictionary as "means of supplying a want, or stock that can be drawn upon". Such a definition embodies the idea of *usefulness*, now or sometime, and also the idea of a *supply* that could be made available, used up, or replenished. Renewable resouces then are those means of supplying a want that, at least under some conditions, do not diminish with use or which are replaced naturally so that there is some further stock available for future use. I expect that during much of this week we are going to be talking mainly about *living resources*: — animals used for food and economic gain, fish, birds, forests and to a lesser extent other vegetation, soils, etc. But we certainly must not neglect the non-living renewable resources — water, air or wind when it can be made to serve a useful purpose, snow and ice when it can be used as a construction material or transport surface, etc. Nearly everyone will agree that these kinds of things are, or can be, *resources*.

But, given the objectives of this workshop, i.e., to examine how renewable resources fit into the economy of the north, it immediately becomes hard to define what is an *economic resource*. The resources that provide a product that becomes, or could become, a com-

modity for market are easy to include as economic. One includes, for instance, Canada geese but not snow buntings. Even though I may never sell my goose in a market, the fact that I can eat her instead of some other food, but that I don't ordinarily eat snow buntings makes my goose an economic resource while the snow bunting is just a cheerful and pretty externality. But what about that V-shaped flock of geese flying overhead, heading north to land on some lake far over the horizon? Do those geese become a resource only when they are in gunshot range, or when they land where somebody can shoot them? Certainly all geese are an important part of the *wealth* of the north, even if they are never shot at. But are they part of the economy? By asking this question, we immediately enter the subjective area of differences in perception of value. To consider the possible answers, we have to consider what is meant by "economy".

I once saw a travel article about a resort lodge just opened northeast of Yellowknife. After waxing eloquent about the lake with its pristine waters, the superb sport fishing, and the luxurious but rustic appointments, the writer became ecstatic about the short clear nights in summer, and then "in the fall, the nights become longer and the visitor is entertained by the glorious aurora, which have been seen by very few people, and which until the lodge was built, had been going to waste". Such a statement, for me, leads to a struggle in perceptions. As a geologist and geophysicist with his heart in the north, the aurora are to me very much a part of my personal wealth and part of the riches of Canada and all polar regions; but the idea that the aurora have been going to waste, until by building a tourist lodge they have now become a renewable resource, — albeit one rather difficult for the lodge proprietor to manage — requires some getting used to.

If we restrict our consideration to the immediate commercial economy, we have no problem: — the scenery around Banff and Lake Louise is a more valuable national resource than the scenery on Axel Heiberg Island, despite the fact that Axel Heiberg is undoubtedly one of the most scenically beautiful parts of Canada. But what kind of *use*, what wants and whose wants must be satisfied, in order to be concerned about economic resources? Are the caribou herds an economic concern only to the extent that they contain accessible meat, with other concerns about their management or protection based on sentiment or aesthetics? We have to think very carefully about these questions and not answer them too hastily, for we will not all come to the same conclusions and the actions we may take on the basis of our conclusions may well be irreversible.

The term "economy" comes from a Greek expression for "management of the household", or perhaps better "management of the establishment" — the dispensation of goods and services that are under one's control. It is of interest that the word "ecology" means characteristics or knowledge of the household. Thus, the original ideas of economy and ecology were closely related. Western business has appropriated the word economy to refer to the administration of resources and the dispensation of wealth and scarcity in a commercial and accounting sense, and biologists and popular environmentalists have adopted the term ecology for that branch of studies and knowledge that has to do with the habits of living things and their relationship to their surroundings, — truly "knowledge of the household".

In traditional western thinking, it has been quite easy to maintain a distinction between the ecology of a region and the commercial economy of the same region. But when we begin to examine the resources of the north, the clear distinction begins to break down. To a degree that is importantly different than commonly admitted in southern Canada, northern communities and social systems have wealth that has little to do with commerce or money.

and have placed important social values on the management of that non-monetary wealth. Renewable resources which cannot easily be given a commercial value may be of overriding importance to community well-being or individual sense of worth, and the realization of such non-monetary wealth may have little to do with the consumption of the resources or the management of them as property. The difficulty in settling land claims titles, and the frustrations and delays (from a company or government point of view) of many environmental impact assessment proceedings in the north, provide examples of this. The broad economy of the north includes an appreciation of the characteristics and management of the entire northern household — that is, the ecology in the larger sense, including the human ecosystem and its spiritual and cultural needs. As a southerner, I know that I cannot manage the ecosystem, although I might inadvertantly impair its functioning, or maybe, with care, help to maintain its productivity in those aspects I care most about. But as a northerner, I know equally well that I cannot help but manage the ecosystem just by existing, because I am part of it, and it is a part of me. And therein lies another aspect of the dilemma.

The Reckoning of the Northern Economy in a Broad Sense

What we all have to try to do, I think, is to look at the economy of the north in a broad sense, and in so doing include both the monetary and non-monetary impacts. We must try to see how the renewable resources, including those that can brought into commercial realization but also those that are part of the richness of the north but not of its commerce, fit into the total picture of all resources and the need for responsibility for their management. We should recognize the essential dichotomy of approach between the economics that deals with property and monetary values and the economics that deals with social values and the smooth sustained working of the total socio-ecological system; and we should not, I suggest, look too hard for the merging of one in the other.

We have to get the best possible handle that we can on the biological realities — I am sure that Dr. Fuller will lead us into that area this morning. And non-northerners must attempt to understand the needs and demands of northern people, in the light of those realities, which Drs. Usher and Hartman are going to disucss. At the same time, northern people have a responsibility to try to understand not only the superficial trappings, the techniques, policies, rules and habits of the southern culture, but also the inner drives and precepts of that culture, which southerners themselves are often very inept at explaining or recognizing. We all have to put these understandings, as best we can, into the context of the political and economic realities of our time, both locally and on a national and world scale.

At the same time we have, I think, to avoid the temptation of adding all the pluses and minuses, the pros and cons, up in some way; for if we do, we are apt to find that the values and priorities of the north are swept aside in such an accounting and decision process by the rush and power of events from outside. The idea of trade-offs is a dangerous simplicity that only has meaning between things that can be directly compared. The attempt to find trade-offs or areas of bargaining is what seems to be happening today, and it may be a part of our dilemma; but it need not happen. We should be able to find a way of appreciating and preserving as very valuable in its own right the lower cultural energy of northern areas, just as we take into account and recognize as vitally important the lower net biological energy of northern environments. We have to find a way of recognizing the special worth of comparatively low-energy northern cultural and non-market economic values for their own distinctive characteristics, and of adjusting the scale and pace of events so that their true benefits can not only be preserved, but can flow outward to enrich the rest of the country.

All of the workshop topics at this symposium contribute to these questions.

We should be careful to avoid falling into traps such as artificially assigning dollar values to resources that do not enter the market, or which, like the aurora, cannot be quantified or managed. To do this simply compounds the difficulties of both monetary accounting and ecological/social accounting, for it makes comparisons based on perceptions which may not be shared or which may not be relevant to those by whom the results are used.

The Need to be Practical When Accounting for Intangible Values

We should be careful, also, when considering the contribution of non-commercial and non-exploitable assets to the broader economy, and when taking into account the intangible social values that attach to those resources, not to become romantic or sentimental. We must not let the evaluation of intangibles become wishful thinking for no change or for a return to the good old days. The net value of a herd of caribou is certainly quite a different thing than the value of the meat or protein that the herd can supply. The net value is different, but it is not necessarily greater. It could conceivably be less. Supposing, for example that a particular herd was seriously over-grazing its habitat, leading not only to problems for the herd but to erosion, threatened destruction of other areas, etc., — in such a case, sensible economic management might be to decimate the herd, getting some quick income from the meat and preventing further losses. The point is, we must not let non-monetary economic accounting become an excuse for blind protection or artificial maintenance of a social or natural situation that is no longer healthy.

To find the right balance of values, in the absence of convenient yardsticks like dollars or jobs, to make vital subjective judgements without being either arrogant or paternal, requires great skill. I don't think we have much skill in this field in Canada, and both northerners and southerners must work hard to develop it. To develop such judgement and accounting skill it is necessary to be able to identify intents, satisfactions and frustrations, as well as units of resources, investments, and cash flow; and to apply the same care and rigour to noting changes in social response or ecosystem behaviour as is applied to gathering data for financial analysis.

We have to end up, I think, with an economic accounting that is not "bottom line" in terms of "Gross Northern Product" or "wealth added", but one that is based on a running assessment of the gains or losses on a continuing dynamic balance, and which judges the health of the regional economy in terms of the health and continued productivity of both the ecosystem and the social system.

Such an accounting will not neglect dollar terms, nor calories of food or energy supplied locally, but it will also apply tests of health of the ecosystem such as the stability of interspecies relationships, maintenance of energy flow through the various trophic levels, and evidence of resilience or distortion when a particular component or population receives an unusual stress through human actions or natural physical factors.

We should look at the accounting for use of non-biological renewable resources in the same critical light. Are we really giving attention to renewable energy technologies adapted to northern conditions and scales? We know that we are not, because in a purely market economy it does not pay to do so. But if a net socio-ecosystem economic accounting were to be applied, I suspect we would find much more justification for development of small-scale hydro, wind furnaces, heat pumps in permafrost, etc. Are we making

imaginative use of permafrost as a distinctive factor in modern technology, or are we "coping" with it because it adds cost to conventional engineering projects? There are good reasons to suspect that a broader accounting system would indicate the net socio-economic feasibility of positive use of many local resources and environmental characteristics, whose use cannot be justified on narrow purely "economic" analysis. We might even ask whether we are letting the aurora go to waste.

To achieve such a broad accounting on a consistent basis, we need to learn to use criteria that are not just dollars and jobs and school desks and hospital beds, although these are important; but we should apply the four basic postulates of eco-development:

— are the key needs of people being better met?

— is the human potential of the region being nurtured and utilized?

— is self-reliance, in use of resources and in management of resources, increasing?

— is a true symbiosis between humans and the environment being maintained?

The answers to these questions will come close to defining changes in the net social economy of the north, and its relation to resource use.

Trends in the Accounting of Northern Resources

Accounting in an appropriate manner for the success or failure of northern resource management is difficult for a number of reasons, including, e.g. giving due consideration to both tangible and intangible values and recognizing that the evaluation, necessarily based upon individual perceptions, is subjective in nature. A further difficulty for managers and policy-makers, and also for those who benefit from the use of the resources or who suffer if they are destroyed, is that the base of values is constantly changing. Just as inflation can nullify expected benefits in dollar terms or make nonsense out of carefully laid financial plans, so can changing values placed on intangible assets and changing expectations of resource use profoundly alter the net worth of resources or the benefits to society from their management. This difficulty is encountered by society everywhere, of course; but it is particularly acute in the north, where the economic and social system, like the biological system, is rather simple compared to that in the south, and in the absence of built-in checks and inertia, vulnerable to rather larger swings in behaviour or response due to outside differences or change in any one component than would be expected from the same stress in more temperate regions. An important part of the skill in resource management and policy formulation in the north, just as it is an important part of the skill of an individual living successfully in arctic regions, is the ability to keep a relatively consistent sense of direction and progress even though the economic and social baseline is constantly changing.

If you do not feel that there has been a significant difference in the pace and nature of social and conceptual evolution in northern Canada compared with that in the south, I would ask you to make a simple test. Take any two communities in northern Canada, and any two communities in southern Canada, and think carefully about the changes with regard to renewable and non-renewable resources in the present century. Forget about the technical developments — the guns, the aeroplanes, the radios or the commercial market for Inuit carvings; they are largely trappings and expressions of deeper changes, although south-

erners like to confuse the tool with the purpose. But compare, in these northern and southern communities, the attitude toward non-renewable and renewable resources and the value placed upon them in 1900, 1925, 1950, 1975, and what may be expected in the year 2000. Do this carefully, based on your own subjective impressions of what people in the north and south cared about in each generation. I think that you will find, if you put the technological trappings aside, that you finish with a not very different sense of values from those with which you started, but that the course taken in the north and south was different. Northern communities were struck much more suddenly, and later, with changed concepts based on changed perceptions of resource values; but they have reacted more rapidly and in many ways more coherently in achieving a new and compatible sense of integration between natiural resources, social values, and economic objectives. In this respect, as regards the evolution in society of more coherent value systems, the north may now be leading the country as a whole; and we see evidence of this in the sophisticated legal ideas, coming from northern people and their values that are now entering agreements between the central government and northern people; or in the comprehensiveness and clear sense of priority that can be found, for example, in some conditions put forth for land claims settlements, which our existing and sometimes inconsistent policies find hard to deal with.

It is very dangerous to attempt to discern trends or directions in a fast-moving complex situation. But for the sake of argument for this symposium I will hazard a summary of some changes that might show in what direction we are heading with regard to resource management in the north. It seems to me that:

i) the distinction between *non-renewable* and *renewable* resources in the north, in a management sense, is disappearing. Successful resource management policies will require us to manage most of our resources as *non-renewable*, and thus vulnerable to disappearance once they have been exploited. This approach appears necessary because conditions of resupply of renewable resources are in themselves non-renewable, and it is the conditions for re-supply, not the resources themselves, that we have to manage for the future.

ii) there will be a progressively greater involvement of non-commercial resource assets in the economic system of the north. This will come about because of deeply-held, and strengthening, social value systems of northern residents; however, this trend is bolstered by social pressures from the south which have a quite different basis, and it is also supported by the need of industrial developments in their own self-interest to take greater account of the environmental and social aspects of their operations.

iii) there is an increasing trend to make the "service" or the "opportunity", rather than the identifiable product of renewable resources, a commodity in the economic system. Thus, it is the right to hunt geese in the spring, or the presence of a caribou herd and the opportunity to hunt, that is being negotiated, not the details of a management scheme that will apportion a supply of geese or caribou or maintain the provision of a local food resource or a balanced diet. The James Bay Agreement contains many examples of negotiation over the "service" role of renewable resources, and may mark a turning point in government recognition that renewable resources have an importance that goes far beyond the impersonal and interchangable values of the market place.

Resource Management and the Northern Ecosystem

Successful management of northern renewable resources is nothing less than the management of selected components of the northern ecosystem in such a way that the ecosystem as a whole remains as productive and resilient as possible and that its components are satisfactorily integrated with social values. Both the natural ecosystem and the socio-economic systems in the north are relatively simple, highly stressed by the physical environment, and subject to rather wide changes in behaviour in response to external influence. But both systems are remarkably tough. Our task is to examine and to try to appreciate the characteristics and constraints of northern renewable resources in the context of both ecosystems and economic systems — which are really the same thing —, and to try to identify the management opportunities that will maintain or enhance the health of both systems, without reducing the diversity of either or destroying the toughness.

FISH, FUR AND GAME IN THE NORTHWEST TERRITORIES: Some Problems of, and Prospects for, Increased Harvests

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Modest annual returns produced in perpetuity may take on major significance in the long term, at least for people who neither march to the drums of high interest rates nor are trapped in 4-year election cycles.

H. A. Regier, 1978.

The Berger hearings and report focussed a great deal of attention on renewable resources — an attention long overdue in the opinion of many. In the euphoria of the times, however, the ability of the renewable resources of fish, fur and game to support a human population in the traditional life style was frequently exaggerated. Obviously, in a land with severe limitations on primary production, there is a limit to the size of harvest that can be taken in perpetuity.

The Science Advisory Board of the N.W.T. was born as Justice Thomas Berger's pipeline inquiry hearings (see Berger 1977) were reaching a climax, and the Board decided to take on, as its first major task, a study of the human population and the renewable resources that support it. Accordingly, consultants were engaged to bring together what is known about the human population (Hamelin 1979), freshwater fish (McCart and Den Beste 1979), marine mammals (Davis et al 1980), terrestrial mammals (Dickenson and Herman 1980), and the nutritional value of country foods (Schaefer and Steckle 1980). This report is based largely on the results of those studies. Many of the raw data are available in a report by the Board to the NWT Legislative Assembly (Science Advisory Board 1980).

Constraints on Production of Fish, Fur and Game

The basic constraint is limitation of the amount of radiant energy falling on the N.W.T. that is captured by plants and thus made available to animals. This comes about because the growing season is short; the sun's angle is low; fertility of the soils and water is low; soils are cold because of permafrost, and lake waters are cold because up to half of the year's solar energy has fallen before the ice-cover has disappeared; decomposers are inefficient in cold soils and water; diversity of plants and animals is low; and so forth. In addition, populations of many animal species fluctuate cyclically with a period of either four or 10 years. Given that situation, the concept of an "average take" can be quite meaningless.

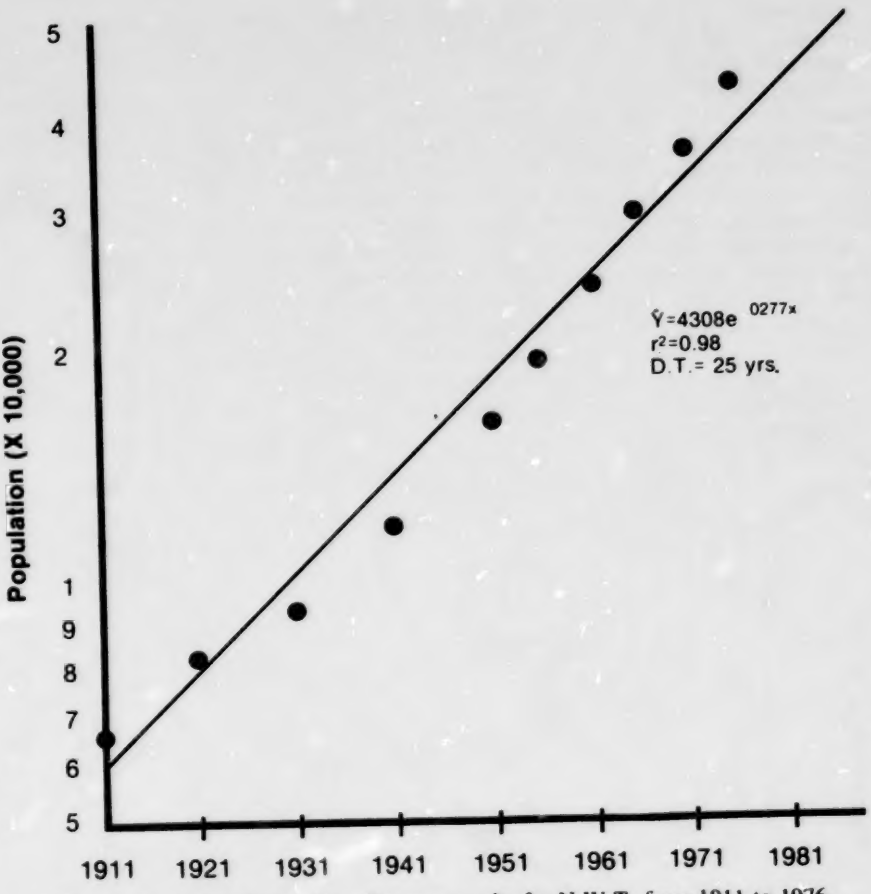

Fig. 1 Semi-logarithmic plot of census results for N.W.T. from 1911 to 1976.

The Human Population

Census figures from 1911, when the N.W.T. assumed its present form, to 1976 form a nearly perfect exponential series (Fig. 1). The instantaneous rate of increase per person (r) has been 0.0277, corresponding to a 2.8 per cent finite rate of increase per year. The doubling time has been 25 years, and the coefficient of determination of the line (r^2) is 0.98. However, it is clear by inspection that the rate of increase was slower before 1951 than after. The series of five points (1911−1915) yields a line with a lower slope (r = 0.0219) and a coefficient of determination of 0.99 (Fig. 2). The doubling time for this series is 31 to 32 years. Since 1951 there has been a very rapid increase in numbers, largely because of immigration. Thus, some of the assumptions of the exponential model are violated. Nevertheless, the data conform perfectly to an exponential (r^2-1.00) with "r" = 0.0390, and a doubling time of just under 18 years (Fig. 3).

Hamelin (1979) made two projections of growth from 1976 to 1985. We used the higher of his two estimates for 1981, and his figure for annual growth rate, as the base for our

own projection to 2001. We assumed that growth would continue to be exponential as it has been for the last 70 years. According to this model, 9140 Dene, with r = 0.022, would increase to about 14,700 by 2001 (Fig. 4), and 17,228 Inuit, with r = 0.037, would reach about 37,500. The total native population (excluding Métis and non-status persons of Dene descent) would then be about 52,000 in 2001. However, the Inuit rate of increase is unlikely to remain at 3.7 per cent. If it were to drop to the Dene level of 2.2 per cent essentially overnight, the total native population in 2001 would be about 42,000. The rate of increase is unlikely to fall much below the latter number because of the large number of young people who will enter their peak reproductive years in the next 20 years. The total native population in 2001 will likely be between 42,000 and 52,000, probably closer to the former, and possibly marginally smaller than 42,000. This compares with the estimated 26,268 in 1981 and the 22,525 recorded in the 1976 census. Our estimates of available resources are based on data inclusive of 1979. In that year there were an estimated 24,400 total natives. If the population reaches 42,000 in 2001 we must plan for a 70 per cent increase in resource harvest over current (1979) rates if the same proportion of the total hopes to reap the same proportion of its support from the resources of fish, fur and game.

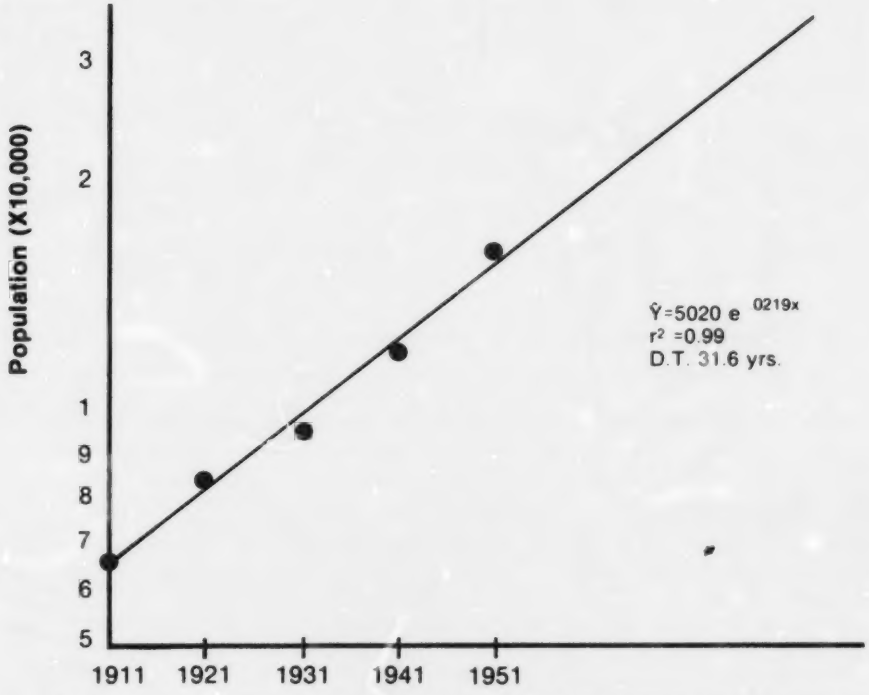

Fig. 2 Semi-logarthmic plot of census results for N.W.T. from 1911 to 1951.

Subsistence Resources — Fish and Game Supply

We made an estimate of the protein content of the recorded harvest of fish and mammals in 1978–79 (Table 1). Fish, including those in the commercial catch from Great Slave

Lake, constituted about 55 per cent (565 t out of 1040 t), seals about 12 per cent, whales about four per cent, and terrestrial mammals about 29 per cent.

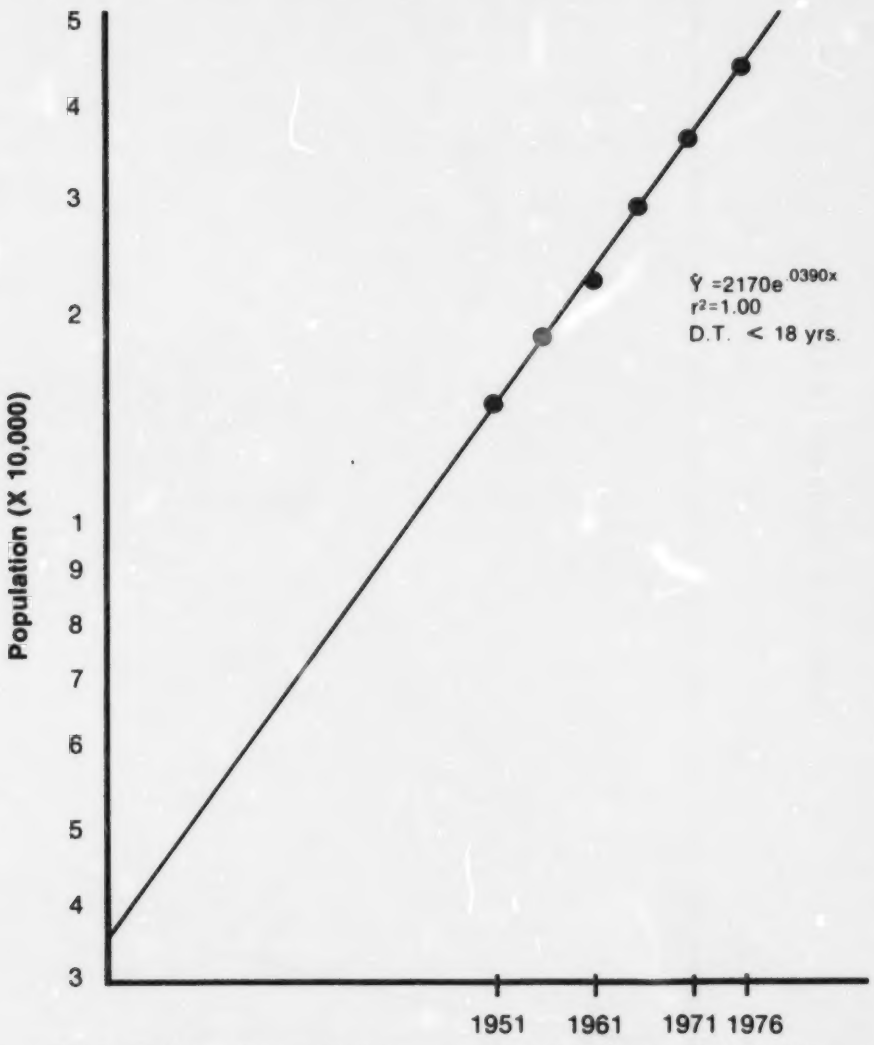

Fig. 3 Semi-logarthmic plot of census results for N.W.T. from 1951 to 1976.

We also estimated a possible future availability of protein. In the absence of historical records, it is even more hazardous to estimate future animal populations than it is to project human numbers. A couple of our projections, frankly, border on the outrageous, so that we consider these numbers (Table 2) much closer to the upper than to the lower limit. For freshwater fish we used the rule of thumb that harvest could reach 0.5 pounds per acre of

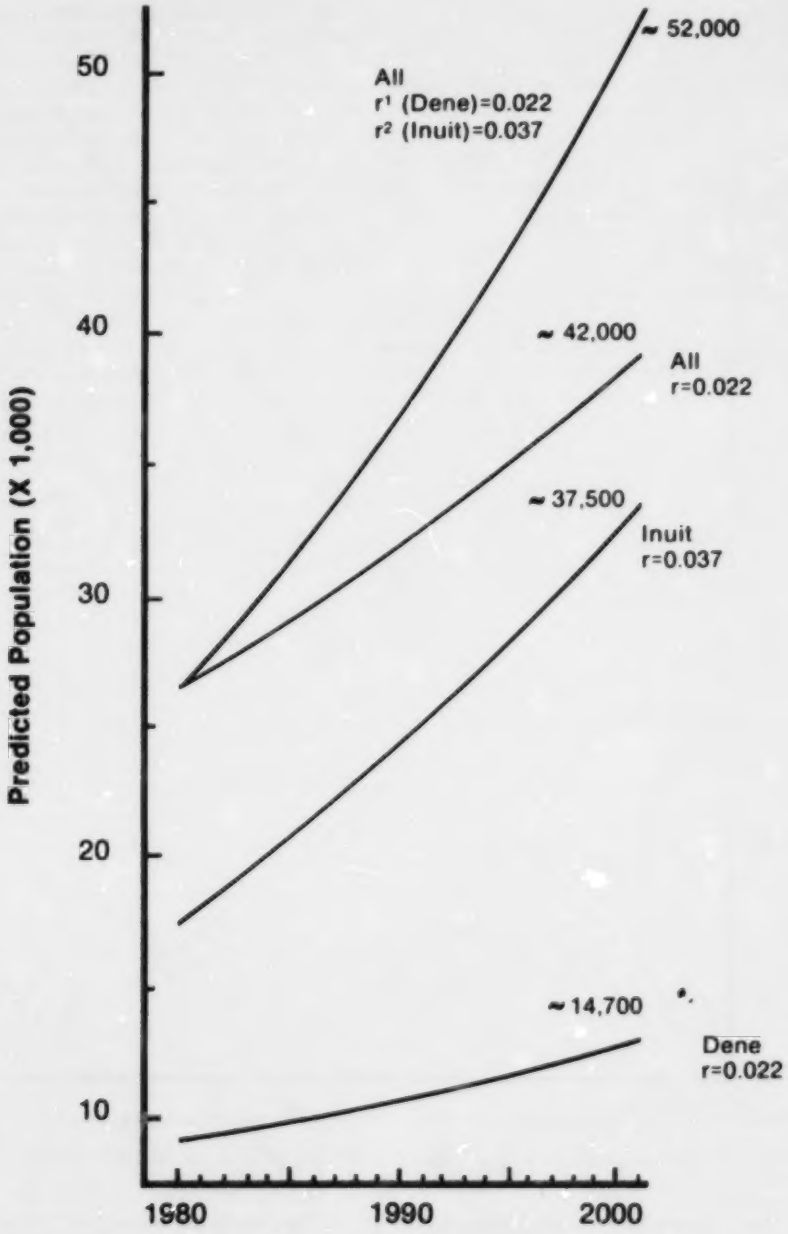

Fig. 4 Population projections for Dene, Inuit, and total native population to year 2000 assuming exponential growth and rates of natural increase as determined by Hamelin (1979).

surface per year, and we applied that factor to all water bodies having a surface area of at least a township (36 sq mi). There is virtually no information on which to base an estimate of the fish and invertebrate production of the Arctic Ocean. However, a quota of 1.3 million pounds has been assigned the Beaufort Sea, which would provide nearly 120 tonnes of protein. Greenlanders have been harvesting shrimp from Davis Strait for some years, but whether or not the Canadian waters would produce the 455 tonnes of protein allotted it is not known.

Table 1. Estimate of Currently Available Protein

		1978/79 Harvest (Weights in Tonnes)		
Source	Protein	No.	Wt.	Protein
Freshwater Fish	0.26			
Domestic		—	910	235
Commercial		—	1,275	340
Sub-total: Fish			2,185	565
Seals				
Ringed	0.32	20,601	290	93
Harp	0.27	2,066	89	24
Other	0.27	1,032	23	6
Whales				
Beluga	0.24	474	97	23
Narwhal	0.24	472	91	22
Ungulates				
Caribou	0.27	20,367	926	250
Muskox	0.25	252	23	6
Moose	0.26	500	102	27
Bison	0.25	30	7	2
Polar Bear	0.26	175	48	12
Sub-total: Game			1,696	475
Total Available			3,881	1,040

N.B. Some discrepancy may appear in the final column due to rounding-off of weight values shown in the table.

The small increase shown for caribou may seem strange in the light of recent declines in mainland herds. However, the figure shown is computed on the basis of caribou population densities that were obtained from the well-researched Coats Island herd. Unfortunately that particular herd suffered a dramatic decline over the winter 1980–81, suggesting the population had exceeded a sustainable level, which casts some doubt on whether the estimated production could be sustained elsewhere. We also estimated a modest increase

in the moose harvest, even though the reported kill has shown an exponential decline averaging about 8.6 per cent per year over the 13 years ending in 1976 (Fig. 5). If the decline is the result of reduced stocks and not reduced hunting effort (on which our prognosis is based), the future status of the moose population could be of serious concern.

Table 2. Possible Future Availability of Protein

Source	Protein	Potential Increase (Tonnes)	
		Wt.	Protein
Freshwater Fish	0.26	3,780	976
Marine Fish	0.26	364	94
Invertebrates	0.25	1,820	455
Sub-total: Fishery Products		5,964	1,525
Ungulates			
Caribou	0.27	165	44
Moose	0.26	102	27
Bison	0.25	283	71
Sub-total: Game		550	142
Total		6,514	1,667

N.B. Some discrepancy may appear in the final column due to rounding-off of weight values shown in the table.

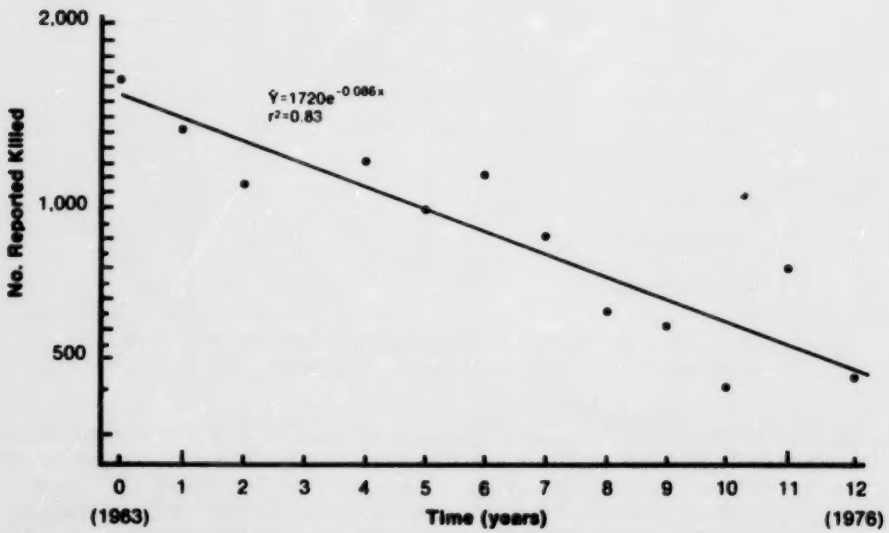

Fig. 5 Moose harvest in N.W.T. showing exponential decline from 1963 to 1976.

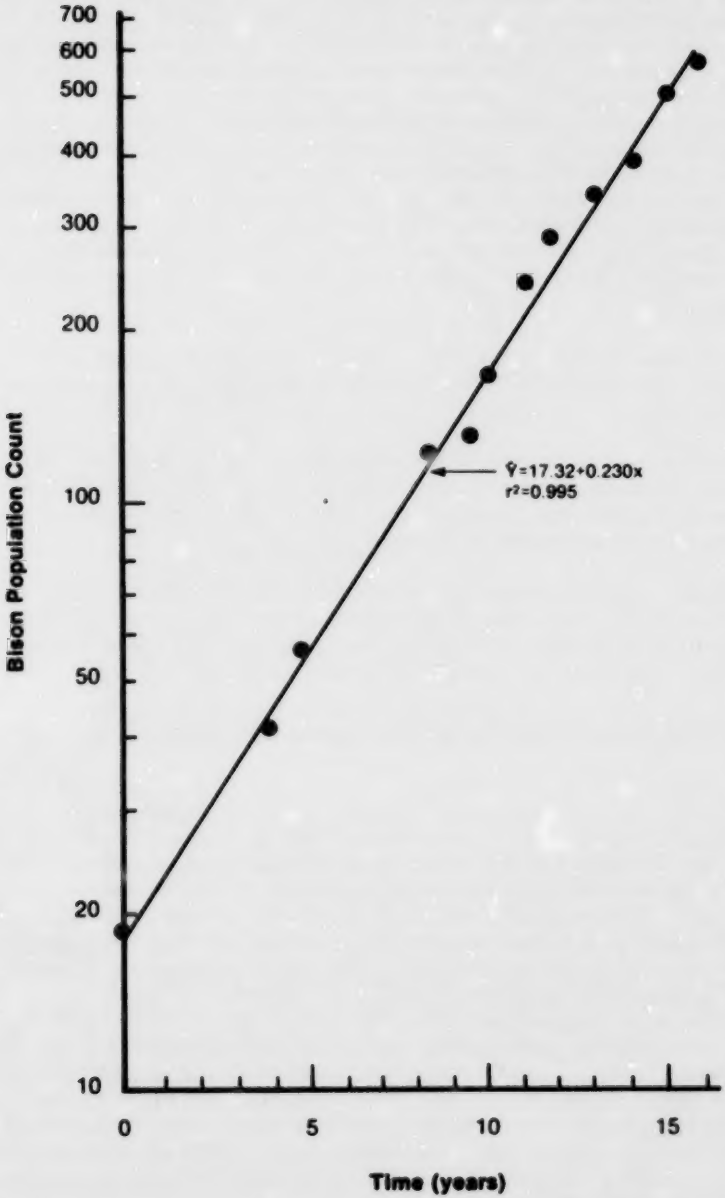

Fig. 6 Exponential increase in bison numbers, Mackenzie Bison Sanctuary from 1963-1981.

Data Source: N.W.T. Wildlife Service.

The brightest spot in the entire picture is the growth of the small herd of 18 bison released in the Mackenzie Bison Sanctuary in 1963. At last count (March 1980) the herd numbered about 650, and, as Fig. 6 demonstrates, it increased exponentially at an instantaneous rate of 0.23, or a finite rate of 26 per cent per year. It seems reasonable to suggest that this is about the maximum rate to be expected. Bison sex ratios are even at birth, but probably favor females in older age classes. For the sake of an example, we assume a 55:45 ratio. From the 55 females we can subtract 13 female calves, leaving 42 females older than one year. If as many as 10 of 13 calves from the previous year survived to become yearlings, then 32 females older than two years produced 26 calves. In Wood Buffalo Park not all two-year-olds become sexually mature, so that virtually all females that are mature must have a calf every year to account for the observed rate of increase. Clearly, the feasibility of reintroducing bison elsewhere in the southern Mackenzie District ought to be seriously investigated.

These somewhat optimistic extrapolations result in an estimated future potential of 1,667 tonnes of protein, compared with the 1978-79 figure of 1,040 tonnes — an increase of 160 per cent.

In Table 3 we have an estimate of the protein demand of the estimated 1980 human population. Our median estimate is about 75 per cent of the 1978-79 harvest (Table 4) and the maximum available supply is apparently about 3.6 times the current demand. However, these figures are misleading for a number of reasons.

Our estimate of available protein may be low for the following reasons. First, the actual kill was undoubtedly greater than the reported kill. Those who commit excessive slaughters are least likely to report their kill accurately. Second, small game such as hares, grouse, and waterfowl are not included. Third, many fur bearers, like muskrat and beaver,

Table 3. Estimated Protein Demand for Human Population of N.W.T. in 1980

		Protein Requirement (g/day)				Annual Demand (Tonnes)		
Age/Sex	Years	Min	Max	Med	No. in Cohort	Min	Max	Med
Infants	0–1	7	15.4	11.1	1,348	3.44	7.58	5.46
Children	1–9	18	37	27.5	10,876	71.46	146.88	109.17
Adolescent ♂	10–19	38	54	46	5,623	77.99	110.83	94.41
♀		38	43	40.5	5,339	74.05	83.80	78.92
Adult ♂	20–80	56	56	56	13,425	274.41	274.41	274.41
♀(1)		41	41	41	10,886	162.91	162.91	162.91
♀(2)		61	65	63	1,348	30.01	31.98	31.00
				Total:		694.27	818.38	756.28

Note: (1) Not pregnant or lactating
(2) Pregnant or lactating; arbitarily equal to number of infants

Sources: Protein requirements taken from Canadian Bureau of Nutritional Sciences standards; population data taken from Hamelin 1979.

are also eaten. Fourth, seals may be underharvested at present. In addition, our estimate of demand includes residents of European extraction who derive most of their protein from imported foods.

Table 4. Summary and Ratios

	Protein Supply & Demand (Tonnes)		
	Game	Fishery	Total
1978/79 Supply	475	565	1,040
Additional Supply	142	1,525	1,667
Maximum Supply	617	2,090	2,707
Median Demand			756

$$\frac{\text{1978/79 Supply of Protein}}{\text{Median Protein Demand}} = 1.38$$

$$\frac{\text{Maximum Supply of Protein}}{\text{Median Protein Demand}} = 3.58$$

$$\frac{\text{Maximum Supply of Fishery Products}}{\text{Maximum Supply of Game Meat}} = 3.39$$

$$\frac{\text{Maximum Supply of Fishery Products}}{\text{Maximum Total Supply of Protein}} = 0.77$$

On the other hand, there are a number of reasons to reduce the estimate of the sustainable level of protein harvest. First, some caribou herds certainly, and moose possibly, are being overharvested, so the amount available on a sustained yield basis should be less than reported in 1978-79. Second, the commercial fishery is included, although virtually the whole catch is exported at present. Third, we have no estimate of the numbers killed but not recovered, wasted, or spoiled. Fourth, people following the traditional life style derived more than 40 per cent of their calories from protein (Schaefer and Steckle 1980). To provide 1000 Kcal per day by gluconeogenesis would require at least 230 gm of protein, or four times the daily requirement for an adult male used in constructing Table 3. (The *net* energy may be only about half the theoretical 4.3 Kcal/g so that the requirement may be even higher by a factor of two). Fifth, any additional supply of protein depends very heavily on fish, which must come from all corners of the Territory, regardless of cost. Sixth, we have no reason to think that people want a diet that would be about 80 per cent fish, or that they will develop a taste for shrimp.

In our view, then, it would be unwise to count on more than a doubling of the numbers that can ever be supported on wild fish and game if the intensity of use remains at about the same level as it is now. However, most of this margin for increase will be used up by the year 2001. The unused 20 per cent or so is a small enough safety margin.

We analysed statistics of fur catches from the 1957-58 season to the 1978-79 season — 22 years, except in the case of seals, for which no data were available 1957 to 1961. Because there is a great deal of annual fluctuation in both catch and price, comparisons of single years are rather meaningless. Over the period studied, for example, the value of the catch, in current dollars increased about six-fold, from about one million dollars in 1957-58 to nearly six million dollars in 1978-79.

Table 5. Average Annual Catch and Dollar Value of 11 Important Fur-bearers, 1957-58 to 1961-62. CPI = 80 Compared with 1971 = 100

	Average Annual Catch	Average Annual Value		
		Current $	1971 $	Rank
Seal	30,729[1]	276,254	345,317	2
White Fox	26,875	456,337	570,422	1
Mink	7,125	143,426	179,283	3
Muskrat	201,269	118,748	148,436	4
Beaver	7,505	83,456	104,320	5
Marten	8,917	61,438	76,798	6
Polar Bear	481	24,921	31,151	7
Lynx	2,434	23,902	29,877	8
Squirrel	26,165	8,372	10,465	9
Weasel	5,391	3,612	4,515	10
Coloured Fox	570	1,784	2,230	11
Total:		1,202,250	1,502,805	

[1]Data for 1961-62 to 1965-66 because 1957-58 to 1960-61 not available.

Five-year averages, with price "corrected" to 1971 dollars according to changes in the Consumer Price Index, tell a different story. In the first five years, white fox led in value, followed by seals, then the other species in the order listed (Table 5). A few comments are in order. Lynx, certainly, and muskrats probably, have 10-year cycles of abundance (Finerty 1980), as did marten and mink in earlier times. Mink still show some evidence of cycles (see graph of catches plotted in Science Advisory Board 1980), but cycles are not apparent in recent marten data. Given 10-year cycles, even five-year averages can be misleading, since the five years could correspond either with the maximum or the minimum or some intermediate stage.

White fox undergo four-year cycles, so that five consecutive years could include either one or two peaks. This problem is minimized when statistics for the whole N.W.T. are aggregated because cycles are not in phase over the whole territory.

Note that coloured fox contributed very little to the catch in the first five years, when long-haired fur was out of fashion. Note, too, that the average annual value of these 11 species was about 1.5 million 1971 dollars.

Table 6. Average Annual Catch and Dollar Value of 11 Important Fur-bearers, 1974-75 to 1978-79. CPI = 160 compared with 1971 = 100

	Average Annual Catch	Average Annual Value		
		Current $	1971 $	Rank
Seal	35,161	583,184	364,490	3
White Fox	25,846	760,906	475,566	1
Mink	4,967	120,082	75,052	8
Muskrat	177,293	592,513	370,320	2
Beaver	4,799	79,484	49,678	9
Marten	13,964	335,355	209,597	5
Polar Bear	429	299,285	187,053	6
Lynx	2,369	463,663	289,789	4
Squirrel	11,507	8,975	5,609	10
Weasel	2,622	2,485	1,553	11
Coloured Fox	2,158	145,849	91,156	7
Total		3,391,781	2,119,863	

Table 7. Comparisons Between Fur Harvests of 1957-58 to 1961-62 and 1974-75 to 1978-79

	Trend in Nos.	Rank in Value		Change in Rank
		1958-62	1975-79	
Seal	+	2	3	−1
White Fox	0	1	1	0
Mink	−	3	8	−5
Muskrat	−	4	2	+2
Beaver	−	5	9	−4
Marten	+	6	5	+1
Polar Bear	A	7	6	+1
Lynx	B	8	4	+4
Squirrel	−	9	10	−1
Weasel	−	10	11	−1
Coloured Fox	+	11	7	+4

A) Regulated by quota
B) Depends on phases of cycle included.

In the last five years the value of the catch of the same 11 species had increased to about 2.1 million 1971 dollars — an actual increase of about 41 per cent (Table 6). Once again, white fox led in value, but muskrats had a slight lead over seals and mink had fallen to eighth place. The catch of coloured fox had increased nearly four-fold and their value had increased dramatically. In the last year of record the three colour phases were valued at just over $500,000.

Overall, catches of five species declined in number, those of three species increased, two showed no significant change, and one was regulated by quota (Table 7).

There were some rather large shifts in the comparative value of different species. Mink and beaver underwent strong declines in number harvested, and the average value of their pelt was virtually unchanged in current dollars, which means an actual decline in value in constant dollars. Coloured fox and lynx, on the other hand, rose significantly in rank. Both catch and value increased for foxes, whereas lynx increased dramatically in price, but not in catch.

What sort of projection can we make for the future? We have taken the highest average annual catch for five consecutive years, and the highest average annual value for five consecutive years, and used the product of those two numbers as an estimate of a possible upper bound to fur production (Table 8). In all cases the last five years of record gave the highest average annual price, but highest catches came from several parts of the 22-year record.

Table 8. An Estimate of Future Value of Fur Harvests

	Catch[1]	Average Value[2]	Total Value (Dollars)
White Fox	29,963	29.44	882,111
Lynx	4,354	195.75	852,295
Seal	48,146	16.59	798,742
Muskrat	201,269	3.34	672,238
Polar Bear	544	697.31	379,337
Marten	13,964	24.02	335,415
Mink	8,682	24.18	209,931
Beaver	9,310	16.56	154,174
Coloured Fox	2,158	67.60	145,881
Squirrel	26,165	0.78	20,409
Weasel	7,031	0.95	6,679
			4,457,212

Notes: 1. Highest average recorded catch for a five-year period.
2. Highest average value obtained over a five-year period.

White fox is still the most valuable species, followed by lynx, seals, and muskrats. The total value, in current dollars, is nearly $4.5 million, and is 31 per cent higher than the value shown in Table 6 for the five years ending in 1978-79. One could argue that this result is conservative because a) some species, notably coloured foxes, are still being under harvested; and b) species such as wolf, which have become valuable in the current fashion swing, are not included. On the other hand, the highest 10-year running average for marten is 88 per cent of the five-year average used, for mink it is 77 per cent and for lynx only 72 per cent. (five-year and 10-year averages are nearly identical for muskrats, and four-year and five-year averages are about the same for white foxes). Thus, on

balance, it appears that only a modest increase in the number of people who can earn a substantial part of their living from trapping can occur.

If our estimate is at all realistic, the 11 species we dealt with might contribute an additional million dollars to trappers' incomes. Adding in minor species (and the wolf which is at the moment not minor) might increase that figure to $1.5 million. In the late 1970's the number of people who sold fur in a given year varied from about 3,500 to 4,000. Of those, about half sold no more than $400 worth of fur, and only about one per cent sold more than $8,000 worth. From 1975-76 to 1977-78, the average income from sale of furs was $898. Thus, an additional $1.5 million could support another 1,670 trappers at the average level. Alternatively, it could support about 150 trappers at an average income of $10,000. To achieve substantially increased harvests in perpetuity will require harvesting fur from all parts of the N.W.T., not just easily accessible areas close to settlements and major travel routes. To operate in remote areas is expensive, and therefore requires a return of considerably more than the average of less than $1,000 per trapper per year. If the potential additional income were distributed in this way, there would be essentially no room for more trappers than there are now. Redistribution of trapping effort by the present trapping population could absorb the excess income.

But if we accept the other extreme, and assume that a constant proportion of the increasing population will be trappers, then the native population will be about 33,000 when the additional 1,600 trappers are added to the number operating in the late 1970's. From our Fig. 4 that should occur sometime between 1987 and 1990.

A Note on Economics of Fur

We examined our data with reference to two hypotheses. H_1: if the so-called law of supply and demand were operating mean catches and mean prices ought to be negatively cor-

Table 9. Correlations between Average Catches and Average Prices

	Catch		Price			
Species	$\bar{X}$	S.D.	$\bar{X}$	SD	R	R_s
Lynx	2,685	1,731	61.79	84.29	0.04	0.04
Marten	11,052	4,635	13.46	7.61	0.48(1)	0.14
Mink	5,555	2,587	20.36	5.07	0.22	0.17
Muskrat	169,688	60,861	1.56	1.15	−0.19	−0.23
White Fox	23,367	10,379	18.65	8.49	0.14	0.08
Beaver	7,125	2,093	13.37	3.21	−0.47*	−0.59*
Squirrel	15,597	8,876	0.47	0.28	−0.37	−0.46
Weasel	4,471	2,568	0.71	0.21	−0.26	−0.25
Cross Fox	320	305	28.52	38.13	0.94***	0.89***
Red Fox	678	584	20.61	25.16	0.88***	0.79**
Wolf	510	246	49.35	53.88	0.69**	0.79**

Note: (1) Not significant for first 20 years of data. Marginally significant when last 2 years are added.
*$P < 0.05$ **$P < 0.01$ ***$P < 0.001$

related. We predicted that negative correlations would most likely occur in cyclic species, for which catches are predictable so that prices could be manipulated according to anticipated supply. Our alternative hypothesis, H_2, is that if high prices stimulate greater effort on the part of trappers to increase catches, catches and prices should be positively correlated.

H_1 seems not to hold. Four of five cyclic species had positive, but non-significant, correlations (Table 9). Only muskrats had the predicted negative correlation, and that was far from significant.

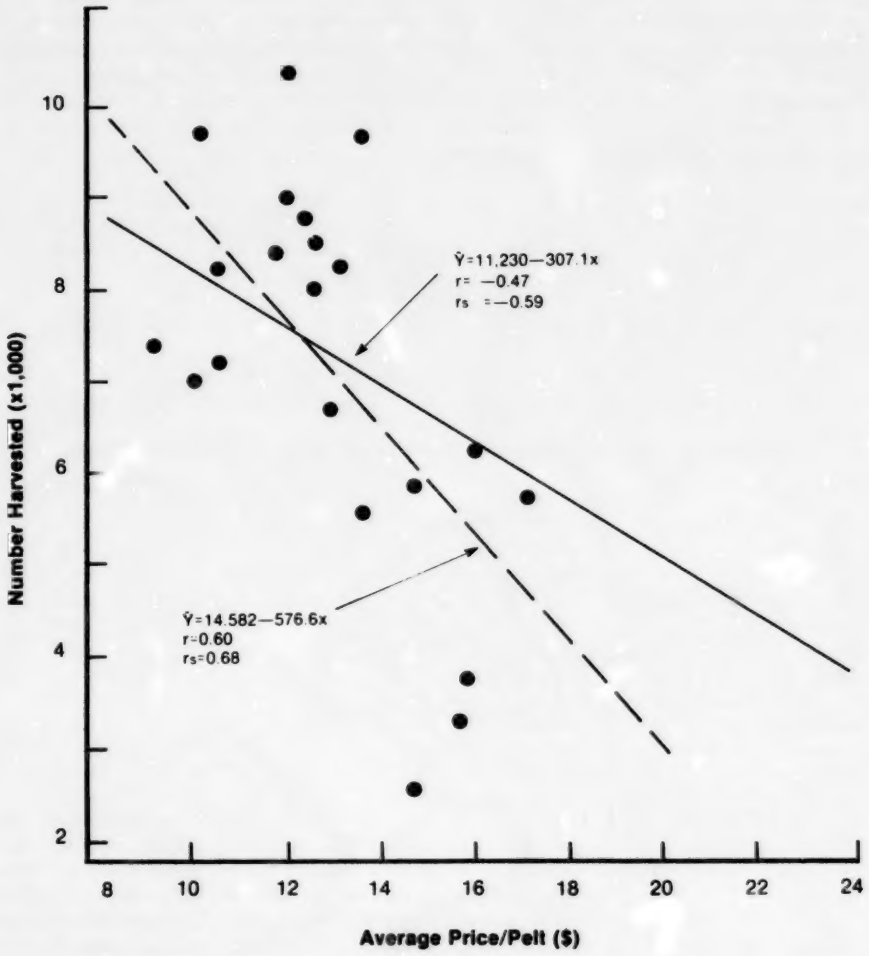

Fig. 7 Correlation between average annual harvest and average annual pelt price of beaver.

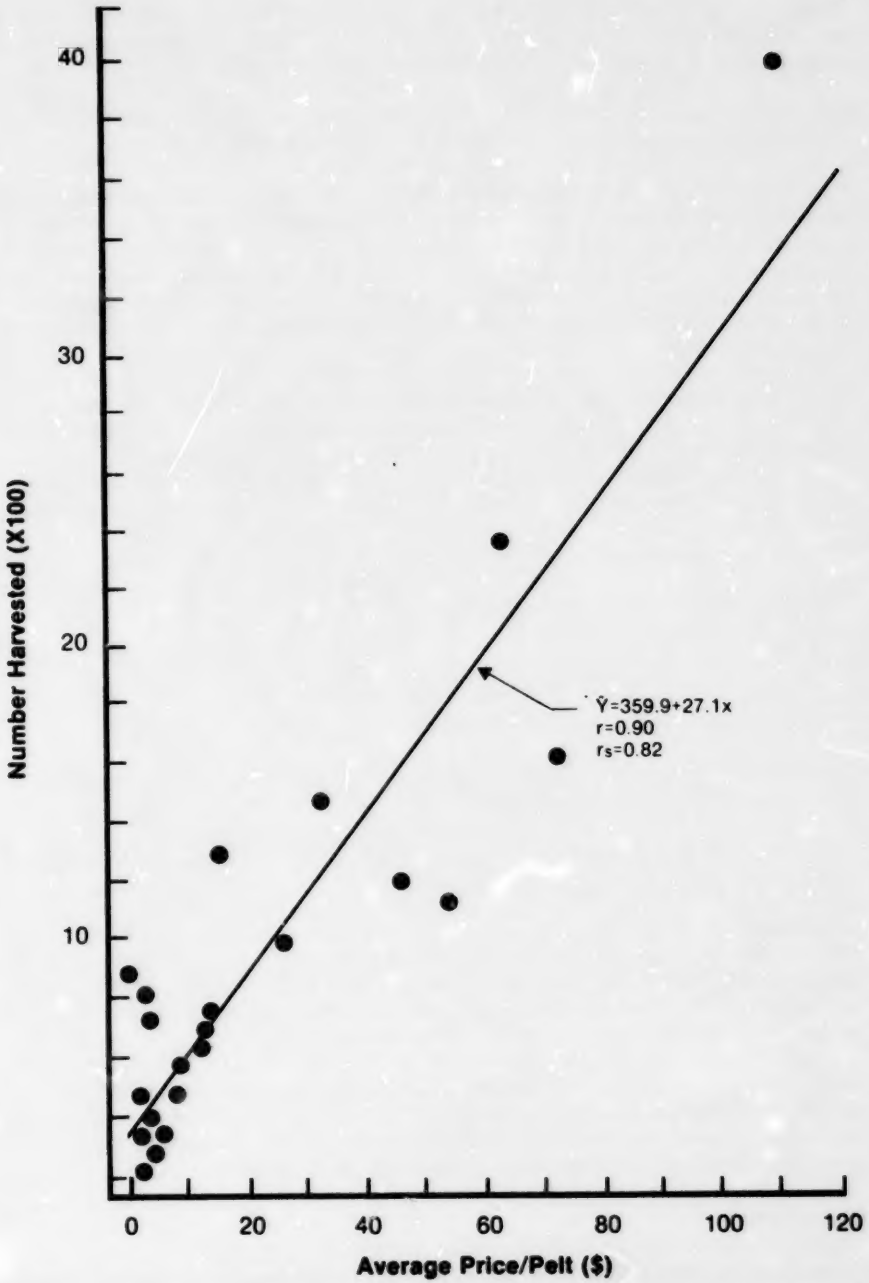

Fig. 8 Correlation between average harvest and average annual pelt price of coloured fox.

Overall, only beaver (Fig. 7) showed a significant negative correlation between catch and price. Why this should be so, we are at a loss to explain. Squirrel and weasel also showed negative correlations that were not statistically significant.

Long-haired species, (e.g. coloured fox, Fig. 8) in contrast, showed a marked positive response to increased price, thus offering partial support for H_2.

There is another aspect to this problem as well. Both harvests and prices vary, as is evident from the standard deviations shown in Table 9. We predicted, a priori, that cyclic species would be least stable in terms of harvests. Once again, we were wrong (Table 10). Coefficients of variation are modest for muskrat, marten, white fox and mink. Only lynx may behave according to our prediction. The most unstable species, both in catch and in price, are those for which there is a strong positive correlation between price and catch (coloured fox, wolf).

Table 10. Relative Stability of Harvest and Price for Major Species of Fur-bearers

	Catch		Price		
Species	C.V.	Rank	C.V.	Rank	ΔR
Beaver	29	1	24	1	0
Muskrat	36	2	74	7	−5
Marten	42	3	57	5	−2
White Fox	44	4	46	4	0
Mink	46	5	25	2	+3
Squirrel	57	6	59	6	0
Weasel	57	7	29	3	+4
Lynx	64	8	136	11	−3
Wolf	68	9	109	8	+1
Red Fox	86	10	122	9	+1
Cross Fox	95	11	134	10	+1

$R_s = 0.700$ $(0.05 > P > 0.01)$

Although the ranks are positively correlated, there are some points worth noting. First, the three species that have the same rank for price as for catch have nearly identical coefficients of variation for both. Second, of the remaining species, only two (mink and weasel) are less variable in price than in catch, whereas six species are less variable in catch than in price. Finally, the four highest coefficients of variation are in price. Thus, the wildlife manager is in the position of trying to manage a resource subject to two important variables while having only partial control over only the less important of the two. This is an intolerable situation, and one of the questions with which this symposium should grapple. How can order be put into the present chaotic state of the economics of fur?

Conclusions

On the basis of rather liberal assumptions we estimate that the protein-yielding fish and big game resource might support a maximum of double the 1976 population, which will likely be attained by the end of this century.

The money-yielding fur resource appears to have less elasticity. We predict an increased value of not more than 31 per cent over that of the late 1970's. If the population of trappers grows at the same rate as the native population as a whole, the industry will be saturated in the late 1980's.

Gross incomes from trapping are a product of the number of pelts harvested and the price per pelt. Of the two variables, price undergoes the greater fluctuation for most species, and it is beyond the control of either the trapper or the game manager. Since a small price decline can neutralize gains in productivity resulting from good management, there is no possibility of bringing order to the trapping industry unless prices are regulated.

We also caution that even the modest gains we predict are predicated upon an intensification of all aspects of management of the resource. Inventory information is inadequate for most species. Harvest statistics are unreliable for the domestic fishery and for all game species, whether terrestrial or marine. Hunting, trapping and fishing effort would need to be widely dispersed, which introduces a major economic problem. It probably does not make sense to fish remote lakes and fly the catch to a settlement, for example. Something approaching game ranching in which age and sex composition of the herd can be controlled, may be required to manage island populations of caribou or additional reintroductions of bison. Soviet techniques for managing white foxes might also prove profitable, especially in view of the fact that white foxes are already the most valuable terrestrial fur-bearer. We suggest that money invested in intensified management will be amply repaid in the long run.

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MANAGING NON-NATIVE RENEWABLE RESOURCE USE IN THE NORTH: Rising Expectations in Unproductive Ecosystems

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Introduction

Man, so far as I know, is the only species on earth that reaches for all the resources and space here, and thinking that is not enough contemplates the moon and stars. This aspect of our behaviour may flatter us more for our technological courage and ingenuity than for our decency and compatibility as species.

Many people I am sure would say that this is some sort of an overstatement. It is one leap too far ahead; there are still frontiers to conquer here. They would say that there are vast areas yet in the north of "untapped riches," if I could borrow a common phrase from the developer and the politician. Certainly, it is true that there are resources that the country as a whole wants and resources that it will get in the north; oil, gas, coal, copper, tungsten and hydro-electrical power, etc. These non-renewable resources are the money makers. The north is not empty, as many people in Canada may perceive it, however. There are people there to whom it has been home for long periods, it is not a frontier to them. There are renewable resources there that are important to the residents. There are fish, wildlife and wilderness resources there of unique interest on a national scale.

Even if the north was a last frontier, there would be serious technical, social and ecological problems that should be dealt with before we move into high gear to exploit it. The land in the north does not heal quickly where we mark it, it is not productive and we do not understand it well. To complicate matters we are still debating who should get what in the north.

Considering all these things the following types of questions become more urgent.

- What is the future of renewable resource management in the northern part of Canada?
- What is there? What is the capability of the land to produce forests, fish, wildlife and crops?
- How will these resources be allocated in the light of entry of more and more people to the north, each with their own unfulfilled expectation?
- What do we need to know to manage and protect sensitive ecosystems and vulnerable living components within them in the light of expanding pressures on both renewable and non-renewable resources.

The assumption is made that as a nation we may want to consider such questions. This begs the question of how much cost and inconvenience any of us will put up with in order to respond to them in any fashion other than that of expedience or short-term gain.

"The North" is a very vague way to delineate an area of a country as extensive as Canada.

There are major demographic and geographic differences in various parts of Canada north of 60°. I believe that one or two other papers may deal more intensively with the N.W.T. than with northern British Columbia and the Yukon. The generalizations that I make about the nature of the land may extend to a wide range of areas of northern Canada. However, most of my consideration will be directed to northern British Columbia and the Yukon.

The original request that brought me to this conference was for a paper on non-native use of renewable resources and associated management issues. In examining issues in respect to non-Indians and renewable resources it is necessary to consider two things: the use of the renewable resources and its effects on those resources; and the impacts on renewable resources and the land base as a result of exploitation of non-renewable resources. It is also important to recognize that there are many economic, social and environmental linkages in all areas of the north. These linkages extend from non-renewable to renewable resources, from Indians to non-Indians and from one area of a territory to another. As a result of these aspects of renewable resource matters, my presentation cannot be confined to a simple examination of management of renewable resources for non-Indians.

It may be even more important for us to recognize that how we manage and protect wildlife, fish and the beauty of the land in the north, will depend more on our morality and social goals, and consequent economic activities, than on our technical and managerial skills. Historically man on the "frontier," perceived or real, has been greedy, has been destructive and has been short-sighted. On the assumption that this may continue to be so I must engage in considerations of social goals and indeed national morality as much as the specifics of technical management in the north. In doing so I hope to be able to stimulate thinking about management of renewable resources for non-natives and, hence, retain that focus in this paper. Because I have taken a broad approach I would like to indicate the direction I will follow. In the course of this paper I will attempt to discuss aspects of the following:

- The land, its nature and general limitations.
- The land and its productive capability for renewable resources.
- The numbers and potential numbers of people.
- Renewable resource management, general considerations.
- Fisheries and wildlife management: the resources, their use, their value, and the management process.
- Industrial development, and wildlife and fisheries.
- Philosophical considerations.

The following sections of this paper will proceed through these topics, although not specifically by the titles listed.

My experience in the north has been centered largely in Yukon and has primarily involved wildlife. My training is in fisheries. For these reasons the paper will move from more general matters of renewable resource management in the whole north to more specific matters revolving around wildlife and fisheries in Yukon. If my words are hard it is because I am concerned.

THE LAND AND ITS LIMITS

Northerliness

Canada is the second largest country in the world. Its area is 3.56 million square miles. Yukon and the N.W.T. make up 41 per cent of this area. Most of the area of the N.W.T.

falls within the classes — *far north* and *extreme north* of the zones of nordicity (Hamelin 1979). About two-thirds of Yukon lies in the *middle north zone* and one-third in the *far north*. Hamelin characterized the three areas of nordicity on the basis 10 criteria, among them are population, industrialization, accessibility, vegetation, permafrost, growing season, and precipitation.

Limitations of the First Degree

In any consideration of renewable resource use and management it is imperative that we fully understand the nature and significance of the physical features of the land that have been used to characterize *nordicity*. It is only through such understanding that we will behave wisely in the north. Needless to say, there are a very large number of original people and long-time residents of the north who merit the same special consideration as the land.

I would like to provide as background a brief description of the major features of the land. Virtually all of the Yukon and the N.W.T. receive less than 40 cm of rainfall per year. Almost all of these areas lie in the zones of scattered, discontinuous or continuous permafrost. By far the largest fraction of the land receives less than 635 degree-days C (1500 degree-days F) in its growing season. (Ten degree-days C, e.g., equals two days in which the temperature is 5°C). A part of the upper Mackenzie Valley and central-eastern Yukon has growing seasons of 635-1390 degree-days C (1500-2500 degree days F). The growing season is the number of days with an average temperature over 5.6°C (42°F) (the National Atlas of Canada 1974).

The soils are shallow, poorly developed or absent over a large part of these northerly areas. In many regions soils consist of a thin active layer underlain with permafrost.

The vegetation is sparse or absent. Only the southern Yukon and the upper Mackenzie Valley contain closed boreal forest. North of these areas stretch vast zones of open woodland, tundra, lichen, sedges and bare rock (Science Council of Canada 1977). This is a harsh, cold, unproductive land. These realities of the nature of the north will determine the productivity of the land for forests, wildlife, fisheries and agriculture. They will determine what expectations people might realistically hold for renewable resource use.

Whether the land is *fragile* or not, may depend on definition. It does not heal quickly however, when we abuse it. This reality should govern the behaviour of the essentially urban decision-makers as they set forth with their arrays of programs to *develop, open up* and *use* the land. The north of Canada is not like Sweden or Norway. We cannot view it as such.

Canada's history is flagged with cases where peoples' expectations and demands exceeded the promise of the land. Our history is also scarred by situations where we did not understand the ecological nature of the land and where we consequently abused it immensely. Either way it is the stuff of broken dreams.

Land Capability — Our Information Base

Where should we begin if we wish to behave wisely in the north and still use the land to a degree?

The renewable resource values and capabilities that are usually of concern to us are: forestry, fisheries, wildlife, recreation and agriculture. It is worthwhile for us to look at the land capability within each of these resource or use sectors. It will be of value to indicate the state of our knowledge in these areas as well.

Aside from major project oriented surveys, there is only one major source of consistent, organized information on renewable resources in the north. The Northern Land Use Information Map Series provides eight map sets covering Yukon, the mainland areas of N.W.T., Banks Island, and portions of Victoria Island. These maps, at a scale of 1:250,000, provide a wide range of social and environmental information: e.g., critical areas for fish and wildlife, hunting and trapping areas, ecological land description notes, recreation information, aesthetic information and some climatic and archeological sites data. These maps are useful as background for planners but they do not provide any information on land capability. The data on them have not been gathered systematically or extensively.

The Canada Land Inventory (C.L.I.) program has provided series of maps showing: Soil Capability for Agriculture, Land Capability for Forestry, Wildlife Capability, Land Capability for Waterfowl and Land Capability for Recreation. There is no C.L.I. map system for fisheries. The C.L.I. maps are available for most of southern Canada. They are drawn at a scale of 1:125,000 and rate the land in 7 classes for each resource sector. They describe the nature of the limitations of the land within each class. There are virtually no areas of Yukon or the N.W.T. mapped under this system. The type of information produced through the C.L.I. program is the kind that should be employed in broad regional planning and in making resource use trade-offs in areas of conflict. The maps can provide managers, who are unfamiliar with an area, with a vital initial appreciation of relative resource values.

During the past two years the governments of Yukon and Canada have begun to develop an ecological land classification system. Mapping is underway in key areas of the territory where resource exploitation pressures are anticipated.

Renewable Resources — Some General Potentials and Comparisons

Notwithstanding the fact that the data-base for the north is poor, it is possible to develop a general perspective with regard to renewable resource potential and values. Some of the principle attributes of the land have been described. However, what does this description mean in terms of renewable resources and the capability of the land to produce them? The following remarks are only sketches on forestry, agriculture, fisheries, wildlife and recreation. Nevertheless, they are intended to present a little more clearly the nature of the land's capability for these resources. They should form a further series of guidelines for our expectations.

Forestry

Table 1 shows the total land area of each province and the territories, and the areas of "productive" forest land within them (Smith and Lessard 1971).

The areas of forest land in Yukon and the N.W.T. are relatively very small. It must furthermore be stressed that although the areas are listed as productive forest land the productivity is very low compared to the forest-growing regions of southern British

Columbia. In a paper on the role of high latitude forests in meeting human demands Zivnuska (1977) points out that only a few areas in Yukon, in the Liard, Rancheria, Teslin and Nisutlin valleys, have good timber. These sites have, at best, areas of class 3 capability for forestry: i.e., a productivity of 71-90 cubic feet per year per acre. The rest is made up of class 4, 5, 6 and 7 capability sites.

Table 1. Land areas and areas of forest land in the provinces and territories.

Province or territory	Area (sq km)	Forest land (sq km)
Newfoundland	370,486	87,702
P.E.I.	5,657	2,106
Nova Scotia	76,151	39,057
New Brunswick	72,093	61,867
Quebec	1,356,797	571,419
Ontario	891,198	426,229
Manitoba	548,497	150,710
Saskatchewan	570,271	109,150
Alberta	644,392	301,921
British Columbia	930,533	539,784
Yukon and N.W.T.	3,778,250	196,063

In relation to the areas of total forest land, the "fair" to "good" quality sites are small and far apart. To log large parts of many of the forest areas of Yukon would be destructive to other renewable resources that are there. With regard to the forests themselves, logging them would be equivalent to mining the resource, given the present knowledge and attitudes about forestry in northern Canada. Northern forests, however, are of great value to the local residents for fuel, for home building and for small commercial operations.

Agriculture

The capability of the land for any type of agriculture in the north is extremely limited. A Science Council Report, entitled Food Production in the Canadian Environment, (Geno and Geno 1976), ignores the areas north of 60°. G.D.V. Williams (Lands Directorate Report 1980) quantified and mapped agroclimatic resources in Canada. He rated areas on the basis of a ratio of the number of freeze-free days over 60 to 60. Southern Ontario has an index of 2.5-3, Fort St. John (in interior N.E. British Columbia) has an index of 1. The area north of 60° has index values all of which are 1 or far less. C.L.I. maps of agricultural capability for areas of northern British Columbia and Alberta show very little land with a rating better than Class 3. Virtually all of Canada's potential cropland lies south of a line drawn diagonally downward from the Peace River area in British Columbia to the middle of Lake Winnipeg (Lands Directorate Report 1980).

In Yukon it is considered necessary to allocate grazing land on a basis of 50 acres for one cow. Gardens may be grown in good sites with good care in Yukon. Some examples of good garden crop production have been well documented. They are not good indicators of what might be expected from Yukon as a whole, however.

The boreal zone and the land north of 60° is not agricultural land. Attempts at commercial agriculture, ranching or crop raising, would put people on land that is frequently the best

that is available for wildlife, waterfowl, and fur bearers. Wolves and bears would have to be killed to protect ill-adapted domestic animals. Ultimately, public funds would support such marginal operations in the interest of "feeding the community." Those in the north with a desire to farm should move south.

Fisheries

The fish faunas of Yukon and the N.W.T. are relatively simple. There are 31 species of fish in Yukon and 41 species in the N.W.T., compared to a total of 177 native species in Canada (Scott and Crossman 1973; Lindsey and McPhail 1970). The predominant fish are lake trout, the complex of coregonid species, arctic char, grayling, northern pike and anadromous Pacific salmon. Although the number of species is small, a high percentage of them is very useful as food.

In order to examine the productivity of northern areas for fisheries it is necessary to separate the anadromous and inland species.

Species such as the Pacific salmon that enter the rivers of south-western Yukon, the Yukon River and the Mackenzie River grow in the marine environment. Their productivity depends on fresh water for reproduction but not for growth. They are not limited in the same way inland species are.

On account of the very long severe winters most northern inland waters are very unproductive: ice cover on N.W.T. lakes ranges between one to three metres depth and may persist for seven or eight months. The lakes are relatively young (Johnson 1976). Fish growth rates are extremely low. Although extensive productivity data are absent it is considered that the sustainable fish yield of most northern waters is in the range of 0.5 to 2.5 kg per ha per year. To provide some basis of comparison it might be pointed out that tropical lakes in Africa produce up to 300 kg of fish per ha per year.

Healey (1975a) estimated the maximum production of whitefish in Drygeese Lake, N.W.T., at 5.8 kg per ha per year, of which the production of marketable fish was 1.5 kg per ha per year. Johnson (1976) has stressed the fact that primary productivity and fish productivity in N.W.T. lakes is very low.

Growth rates of fish are also very low. Even though lake whitefish are cold-adapted species they may still reach only 40-60 cm in length in 15 years (Healey 1975b). Lake whitefish from an array of lakes studied by Johnson (1976) commonly ranged as high as 25 years in age, while lake trout ranged well past 30 years in age. Lake trout and lake whitefish in northern Quebec lakes range between 40 and 70 cm at 20 years of age. Many live and grow very slowly until they are 40-50 years old (Power 1978).

Although growth is slow and productivity is low in northern lakes the standing crop is often very high. This frequently leads to the erroneous public perception that fish in northern lakes are very abundant and can be heavily exploited without harm to the stocks. Furthermore, such misconceptions of abundance frequently make the public unresponsive or hostile to management proposals for restraint in use.

Anadromous fish enter the Mackenzie River, the Yukon River and rivers of south-west Yukon. The stocks of chum and chinook salmon that enter the Yukon River and spawn in its upper tributaries are very important. They are used in the U.S. fishery at the mouth

of the Yukon River. For example, chinook salmon are captured and used extensively in food fisheries at Dawson and all along the Yukon River into the Teslin, Nisutlin, Pelly, Stewart and Salmon rivers. They move as far upstream as the drainage of Atlin Lake. Chum salmon ascend the Yukon River to near Carmacks.

The upper tributaries of the Porcupine River serve as spawning ground for large runs of up to several hundred thousands of chum salmon. Fish from these runs are captured and used at Old Crow. Coho, sockeye and chinook salmon and steelhead enter the streams of south-western Yukon (Scott and Crossman 1973). The Yukon and Mackenzie systems and streams of the south-west Yukon, such as the Dezadeash and Tatshenshini, all have tributaries that are of great value for salmon reproduction and early growth. There is further potential for enhancement of parts of these systems for salmon. Salmon spawned in these systems, however, are not limited in terms of growth by the climatic conditions of the north for they feed and grow in the relatively rich waters of the north-east Pacific Ocean.

Wildlife

As is the case with forestry, fisheries and agriculture, the productivity (for wildlife) of the land in the north is very low. Yukon supports something in the order of 200,000 large terrestrial animals in total. To make an extreme comparison we might look at the populations of wildlife in an area of tropical savannah and in Yukon. The Serengeti area is approximately 39,000 sq km and supports about 1.2 million gazelles, wildebeast, zebras, elephants, giraffe, lions, buffalos, etc., or about 31 large animals per sq km. Yukon contains about 0.38 large animals per sq km (Pearson 1977).

In spite of the general low productivity of the land there are many specific areas of Yukon that have high potential for wildlife production. There are many areas that are of critical importance for special phases in the life of each wildlife species. Without such key areas the productive capacity of large surrounding areas is lost.

Severe winters and short summers contribute to a sparse vegetation which in turn results in low reproductive rates in many northern species. The numbers of young born per female are lower than for related forms in the south, and the age at which females may bear young is often higher in the north. As was the case with several species of northern fishes, populations have only a limited capacity to recover from over-exploitation and from certain other environmental stresses.

Although the productivity of the land for wildlife is relatively low the significance of the resource must not be underestimated. Compared to the rest of North America the land base is still largely unaltered in the north: species and communities exist essentially the same as in historical times. High capability wildlife habitat in much of southern Canada is disappearing under reservoirs, pavement, farms and towns. This makes the Yukon's wildlife land particularly significant in the national context.

Recreation

Capability or potential of the land for an array of recreational pursuits is less seriously limited by northern land and climate attributes than is the production of forests and crops. If we consider a spectrum of activities such as canoeing, photography, wildlife viewing, hiking, skiing and touring, there is potential for activity over much of the year. Variable

mountain scenery, open high country and remote rivers attract people to Yukon from most parts of the world. There is an immense recreational potential in much of the north.

The People of the North

The present population of Yukon is about 23,600 and of the N.W.T. about 50,000; these totals represent a population density of only one person per 20 sq mi. In both territories and the proportion of indigenous peoples is large: Hamelin (1979) estimated, for 1979, 8,259 Dene, 16,151 Inuit and 26,635 non-indigenous residents in the N.W.T. Approximately 7,000 Indian people reside in Yukon.

Hamelin (1979) stated that from 1962 to 1976 inclusive there were 82,406 immigrants and 77,335 emigrants in the N.W.T. and Yukon. Although transiency rates are high among non-Indian groups in areas such as Yukon and the N.W.T., there is also a large number of people who have lived there virtually all their lives and intend to stay. It is their home. The unknown demographic variables derive from the occurrence of large, industrial resource-exploitation projects, tourism and national defence. Such large influxes of people may be welcomed by many northerners, particularly non-natives, but they are in fact generated outside of the north and their effects on population behaviour are not well known until they begin to take place.

Acknowledging the tentativeness of demographic projections, Hamelin (1979) lists two possible growth scenarios for the N.W.T. (see Table 2). Munro (1977) projected population growth from 23,000 in 1978 to 40,000 in 1990 in Yukon. This was based on the expectation of economic development associated with a potential railroad extension.

Table 2. Population growth scenarios for N.W.T.

Projection A		Projection B	
Year	Number	Year	Number
1976	43,154	1976	46,500
1977	44,470	1977	47,942
1978	45,856	1978	49,460
1979	47,304	1979	51,045
1980	48,818	1980	52,699
1981	50,391	1981	54,420
1982	52,037	1982	56,213
1983	53,746	1983	58,082
1984	55,516	1984	60,020
1985	57,355	1985	62,037

Source: Hamelin 1979

While any specific growth projection for the north may be quite conjectural it must be recognized that the probability of population expansion is great whether it is to 100,000 or something somewhat less by 1990. From the perspective of renewable resource management and protection the facts that must be recognized are that human numbers, demands and associated impairments to the land will continue to expand. The capability of the land for renewable resource production and the ability of these resources to withstand abuse however will not expand.

RENEWABLE RESOURCE MANAGEMENT

Precedents and Problems

Historically, people's first interaction with renewable resources has been their use of them. Systems of allocation have evolved out of use and use-related conflicts. In North American society, as we have engulfed various frontiers over the past 300 years, our first consideration with resources was their exploitation. The first involvement of government, whether it has been with land, wildlife or trees has been to field teams of people to allocate the resource. In regard to fisheries and wildlife, law enforcement has followed as part of the allocation process. In many government agencies in Canada, involvement has still not moved much beyond the allocation function. Such agencies remain as much hand-maidens to the special interest groups as managers of public resources with the total public in mind. In the north some of our primary and senior legal acts are built around allocation, not protection, not planning. We have only in the last few decades begun to recognize that we should understand the limits in the rates of resource renewability and the problems that revolve around conflicting resource use interactions; e.g., forestry — wildlife — mining. Research, assessment, planning and indeed caution have generally been products of hind-sight in the resource allocation process.

Avoiding Problems

I believe that even now it is too late to avoid much of the legacy of this type of process. However, there are still several major steps that might be taken to provide a much more sensitive management approach to protection and allocation of renewable resources. Some of the following points indicate basic requirements for good renewable resource management. Others indicate the need for better information:

1. A systematic inventory of renewable resource capability must be completed for major areas of the north. Whether this inventory is an ecological land series system or single sector classification (such as used by the Canada Land Inventory) should be up to the users. However, the information should be of a type that allows managers to view northern resource capabilities on a national scale and to make national comparisons. We also require sound methodologies that allow economic values to be put on various renewable resources and their associated options for use. This must include the complex process of valuation of aesthetic, recreational and cultural components.

2. A much more complete and detailed understanding of the functions and interrelationships of northern ecosystems and species is required. Some specific examples of information deficiency and some quotes may illustrate this need.

   There is a total of only 444 papers on fisheries and fish-related matters for Yukon (Cleugh and Russell 1980).

   The numbers, the distribution and the life history biology of many species of Yukon wildlife are poorly understood. This is true in spite of excellent effort by a small group of territorial and Canadian Wildlife Service biologists. The best estimates on the size of the Porcupine River caribou herd for example, are considered to be only within 20 per cent of the real population size. This may mean an error of up to 20,000 animals in an annual estimate.

Although, fire is an integral part of most forest systems and affects both wildlife and wood products production, it is not well understood in the north. Kelsall et al. (1977) state:

Ultimately, we hope that this review will serve as a starting point for a progressively fuller understanding of the close relationships between forest fires and the dynamic ecological character of the Canadian north.

In a paper on aquatic resources in the Canadian north Sprague (1973) stated:

- *that our ignorance of arctic aquatic ecosystems is profound;*
- *that the danger of irretrievably destroying those biological resources is great;*
- *and that basic ecological research should be completed, and effective management procedures established, before extensive northern development is undertaken.*

Although hydro-electric projects are being seriously considered for several major rivers of the north we do not understand, even in general terms, the extent or nature of their impacts on downstream fisheries or on ecological relationships and processes within the watersheds for which they are being considered.

3. There is need to understand the special needs and sensitivities of both the original people of the north and the non-indigenous people who value special ways of life in the north. The present and future aspirations of people must be translated into tangible values and the people then assisted to understand the degree to which their aspirations can be met. The renewable resources of the north will not support an ever expanding number of users.

Usher (1978) provides an excellent discussion of renewable resource use in the north with emphasis on mechanisms, policy and planning. Failures are laid largely at the door of bad plans or over-bureaucratization. What must be recognized, however, is that we may have the best organization, the best mechanical plans, and indeed generous public subsidy. If the land capability is not there, the product will be failure. All strategies, regardless of how well intentioned they are, or what group they serve, do no one a service if they fail to recognize this.

Socially and ecologically responsible policies and programs must be developed recognizing all of the previous elements. Statutes must be prepared and put in place to provide for such policies and programs and indeed to protect them.

There is, therefore, need to establish a consistent and integrated set of statutes that provide for all stages of assessment, protection and planning for renewable resource use. There is an equal need for better laws controlling non-renewable resource use.

Under existing mining legislation miners can essentially do as they please in the name of developing placer claims. If access to working claims is blocked by sensitive wildlife habitat, the developer can simply stake claims across the area in question and then proceed to travel across it with a road. He is free to do so under the guise of working on or developing the claims.

A person who is a non-Canadian can arrive in Yukon and begin staking claims within

hours. Once staked, if mineral values are present, they may be exploited depending primarily on the vicissitudes of the mineral markets. There are no mechanisms for regional planning that might bring on mines in least sensitive areas or in areas adjacent to existing developments or communities. The only control that exists is through land use regulations. However, these regulations operate on the basis that the developer has an almost inalienable right to proceed.

Existing statutes that deal with hard rock mining, placer mining and land use are archaic and allocation-oriented and simply provide no real basis for renewable resource protection.

It is quite clear that the mining lobby has no desire to see the Yukon placer mining or Quartz mining statutes made more responsive to the management and protection concerns of other resource sectors. In addition to this a statute such as the Yukon Game Ordinance has no jurisdiction over the land. Even if it did, it would not have seniority over the pre-existing mining acts and land use act.

Conflicting Jurisdictions and Interests

I cannot speak for the situation in the N.W.T. However, in Yukon the following circumstances prevail: split and competitive federal and territorial jurisdiction, a quasi-independent Indian government, unsettled land claims, a feverish demand for industrial development on the part of many people, and finally a sensitive and non-resilient array of renewable resources. Among the latter, a resource, such as wildlife or fisheries, is caught between inconsistent statutes, is little more than a pawn in claims processes and is subject to impairment from industrial and population expansion. In the light of this, what management needs stand out for these resources in an area such as Yukon? In dealing with this, I will look at management needs that exist because of the role of non-Indians in the north. This role has changed the status of the Indians and changed their ability to exploit the resources. A discussion of wildlife management cannot, therefore, exclude them.

Wildlife and Fisheries Management in Yukon — The Resource

In spite of the fact that the land has relatively low potential to produce wildlife and fisheries in Yukon, those resources are unique, spectacular and of great social value. There are species of mammals and birds that are common in Yukon, yet have almost vanished over much of the rest of North America.

The more than 200 bird species occurring in Yukon include a significant number whose status, according to the national Committee on the Status of Endangered Wildlife in Canada, is either "rare", "threatened" or "endangered". Appendix I provides a preliminary list of the larger mammals, with notes on their status and rough estimates of numbers where known. These data are published (Hartman and Hayes 1980) and can be obtained by writing to the senior author.

Appendix II lists the 31 species of fish found in Yukon with some comments on distribution and abundance.

Within the fauna of Yukon we see species after species that is rare or spectacular, or beautiful, or all three. Some examples are:

Trumpeter swans — Large, beautiful birds. International designation — rare.

Gyrfalcons — Beautiful birds. International value thousands of dollars per bird.

Peregrine falcons — Endangered. International value thousands of dollars per bird.

Barren ground caribou — The Porcupine River herd, one of the largest in the north.

Grizzly bear — Symbolic of wilderness, lost in much of its original range.

Timber wolf — Persecuted all the way from the nursery stories of children to the folk-lore of ranchers and hunters. Extirpated over much of its original range.

Dall sheep — A very beautiful animal. The heart of its distribution in Yukon.

Wolverine — A true wilderness species, rare or absent over most of North America.

Chum salmon — Races that make very long migrations and may be genetically distinct from southern forms.

Chinook salmon — Races that make long migrations in northern rivers.

Grayling — A typical northern species.

Arctic char — A typical northern species — highly prized food and sport fish.

This list could go on and the distinctions could go on. The reality is, however, that these northern species should be considered as something very special; it is a matter of some concern to note the extent to which many species having special status, also are classed as "rare", "endangered" or "threatened" in Yukon.

In regard to management of the land and the individual species it is important to recognize that many of these same species are sensitive to direct disturbance and to habitat disturbance: examples include marten, wolverine, falcons, dall sheep and grizzly bear. Others, because of low reproduction rates or later age at first reproduction, are vulnerable to over-use. Examples are goat, dall sheep, grizzly bear, barren ground caribou and lake trout. Many of these species must make long migrations, or special summer habitat to winter habitat migrations. They are, therefore, vulnerable to habitat dissection caused by roads, utility corridors, railroads and ribbon-type development. The moose, grizzly, sheep and caribou in Yukon occupy open habitat much of the time. Therefore, they are easily visible and vulnerable to hunting. Some species are simply those that many people fear or dislike: examples are the wolf, coyote and the grizzly bear. These species have had a history of conflict with and abuse from people engaged in (usually) marginal agriculture. These wider aspects of fish and wildlife species are important to recognize and they are critical for their management and protection.

Wildlife and Fisheries Management in Yukon — the Uses of the Resource

In Yukon, fish and wildlife species are used by different sectors of the public in different ways. The following list provides a general breakdown of the major uses:

Resource	Group	Use
Fisheries	— Anadromous	Commercial and food
	— Inland	Recreation, commercial and food
Wildlife	— Fur bearers	Commerical use in a primary industry
	— Waterfowl	Viewing, recreation and food
	— Raptorial birds	Viewing and photography
		Falconry markets
	— Upland birds	Recreation, food and viewing
	— Large mammals	Commercial guiding and outfitting
		Recreation and food
		Viewing
		Photography

All the above-mentioned groups have special scientific value based on their distribution, distinctiveness, ecological relationships or behaviour.

Recreational and food use of inland fisheries in Yukon is extensive and is engaged in by many people. A 1975 survey determined that about 14,805 people fished in Yukon; of 12,664 people holding licences almost half were Yukon residents and 44 per cent of these licence holders were from small communities or rural areas in the territory. The licence holders spent about 134,000 angler days and caught over 186,000 fish: grayling, lake trout, dolly varden and pike were the main species captured (Recreational Fisheries Branch 1978).

Licenced hunters kill approximately 3,200 large game animals per year. The following data from an Enforcement and Field Services Section Report (Hoffman 1978), are indicative of the type of game and fur harvests that occur in Yukon (see Tables 3 and 4).

Table 3. Big game harvest in Yukon, 1977-78

Species	Residents	Non-residents	Trappers	Total
Sheep	76	199	3	278
Moose	1,025	177	172	1,374
Grizzly bear	25	71	3	99
Caribou	213	160	931	1,304
Goat	10	23	—	33
Black bear	102	11	9	122
Wolf	—	28	—	28
Wolverine	—	6	—	6
Total	1,451	675	1,118	3,244

The game harvest data do not include numbers taken by Indians. It is estimated, however, that Indians at Old Crow may kill from 600 to 800 barren ground caribou per year. There are no reliable data on numbers of other big game or birds taken by Indians.

Fur harvest information includes all trappers; in 1978-79 a total of 743 trappers were licenced in Yukon of which 224 were non-Indians, 125 non-status Indians and 394 were

Table 4. Fur harvest in Yukon, 1977-78

Species	Number taken
Beaver	506
Red fox	61
Cross fox	41
Silver fox	5
Lynx	230
Marten	1,027
Mink	143
Muskrat	2,748
Otter	17
Squirrel	7,984
Weasel	203
Wolverine	97
Wolf	31
Coyote	22

Indians who, in total, operated on about 353 registered traplines (Achibald 1979). Indians and non-Indians may come closest together in sharing common interests and a common life style in the trapping industry in Yukon.

Although it is known that many people seek wildlife for photography and viewing while hiking, canoeing or even driving there are no data on the numbers doing so. It is known that about 5,500 people canoe or raft down the Teslin and Yukon rivers each year (Personal communication from D. Hutton, Director of Parks and Historic Sites, Y.T.G.) Many other rivers are used by smaller numbers of travellers. All of these travellers come to see wilderness and to see wildlife in a remote situation.

Wildlife and Fisheries Management in Yukon — the Value

One of the most profound mistakes we frequently make is misjudging the value of fish and wildlife. Hartman (1978) estimated the annual total value of fish and wildlife in terms of new dollars and money turnover in Yukon, to be close to $15,000,000. This includes a factor for hunting and for recreational value, but not for value of viewing and photography experiences.

With protection of the land base these values, or some expanding value, may be realized annually until the next ice age.

To this point I have touched on dollar values. It is my personal view that there are cultural and emotional values associated with wildlife that are difficult to define in monetary terms. Regardless of what a dollar may buy, it is clear that some people attach a greater emotional value to it than do others. In the same sense some attach great emotional value to wild creatures and their habitat. Simply knowing that such creatures exist is important to many people. There are may people who believe that species must have, in some universal sense, a right to exist, and this right need not have any relationship to man's use or anthropocentric desires. No matter how one may see this, it is clear from the reactions of many people that wildlife has deeper cultural and psychological value than that which can be

simply assigned to a day's recreation or a pound of moose meat. We in Canada do not own the lions or gazelles of Serengeti, nor should we want to, but we will be poorer when they are gone. I feel the same about the Porcupine River caribou herd. I believe that we should try to emphasize these cultural and psychological values which we put on wild things and places. We should use them to bind us as people of a nation, not to divide us as self-interest groups.

Wildlife and Fisheries Management in Yukon — the Process

There are major components in the management process. At the risk of some repetition of the material given in the general section on renewable resource management, I will go over them specifically for wildlife and fisheries and add comments to indicate why and how these components are of primary importance. In the north managers must do the following:

First, they must understand the ecosystems in which they are working. This implies the need for such things as:

- a sound knowledge of the distribution of ice-rich soils and how they respond under construction, forest harvesting, exploration activities etc.
- a basic appreciation that they are not working in southern Canada;
- a strong operational knowledge of the functions and interrelationships in the system;
- a sound knowledge of the life history biology and population dynamics of the principal species under management.

Second, they must know the productive capability of the region, management unit by management unit. This implies basically knowing enough about water and land productivity to be able to predict how many kilograms of fish may be harvested per hectare, how many moose may be taken per hectare, how many cunits of wood may be cut per hectare; etc. Such use must be predicted on a safe sustainable yield basis.

Third, they must understand the wishes of the users. In the north there are about 32,000 indigenous people. There are also many long-term residents who seek a different life style than normally available in the south. Regardless of the nature of future land claims settlements with the original people, management systems of some sort must be in place with goals and policies that recognize the special interests of the kinds of people mentioned. This is urgent because southern interests are scrambling for oil and gas. The extraction of these commodities could lead to drastic changes in the fisheries and wildlife resources and hence have major impacts on original people.

Fourth, they must know the times, places, scale of other land use activities that will impair the fish or wildlife resource. This is very difficult to do at present: hydro-electric planning is cloistered in as much secrecy as possible; information on mineral distribution is private and largely secret. Exploration takes place freely all over the territory; if a claim appears rich, development may proceed under a flimsy land use permit system.

Fifth, they must understand the impacts of both the developments and the infra-structure associated with the developments.

Sixth, they must have statutory capability that allows the renewable resource manager to participate effectively in protecting the resource and the land base.

Finally, they must have policies that are rational and are supported by the public. These policies and land use approaches need not have the same balance as they do in southern Canada. In regard to policies, Pearson (1978) then Commissioner of Yukon, reflected such thinking when he stated:

> *The traditional system that has evolved in the south is basically one in which forests are managed for trees and timber production. The dominant land use managers are foresters whose goals involve first of all timber and lumber production. Water has traditionally been allocated for irrigation, power, sewage transport and industrial use. In all but the most vital situations, fisheries values are accommodated as an afterthought, if accommodated at all. In some jurisdictions fish have not even been regarded in legislation as users of water.*
>
> *In the Yukon Territory, wildlife values are becoming more unique in the national perspective; the values are high for recreation and they are high for subsistence use. Fur bearers and ungulates are a critical part of the native life style and economy. Current information indicates that most forest systems in Yukon should be managed in strategies predominantly aimed at wildlife, fur bearers and fisheries production.*
>
> *The Territory is managed under a mix of federal and territorial statutes. I indicated earlier that there is a strong tendency in the north to apply administrative and management approaches that have evolved in the south.*
>
> *As an example, fire fighting is a pre-eminent activity in the largely industrial forests of the south. In Yukon, fire is fought to protect human habitation and stands of timber, with commercial wood values in mind, as in the south. These general priorities are understandable. However, the approach to fire in Yukon should be one of fire management rather than straight prevention. We should be looking at policies that go beyond protection or non-protection in different zones. In some areas fire generation may be a very useful land management tool, depending on the capability of the land and the resources we want to enhance.*

The points that have been touched upon involve the broader basic requirements for sound management. These requirements are not well met in the north.

A more specific part of the management process involves allocaiton of the resource. In the allocation process it is necessary, annually, to do the following:

- Inventory the resource — by management unit. This is management inventory.
- Determine level of expected use — in each management unit. This is monitoring the users and their demands.
- Allocate the appropriate number of animals by each unit. This is management and administration. This process and control must extend to Indian hunters as well. Originally Indians hunted from scattered locations: their numbers probably rose and fell depending on the distribution and numbers of wildlife and fish; their mobility was limited and their weapons were simple. Indians now live in communities, they are subsidized by government in many ways, have the mobility of the 4-wheel drive truck, the river-boat, the snowmobile and the aeroplane and have high-powered scoped rifles. Indians like non-Indian hunters now have the capability to easily eradicate populations of wildlife in areas of easy access. Eventually, unit by unit, control will be needed for all users.

— Once unit by unit allocation is planned, it will be necessary to control the users so that they will not abuse the resource by illegally over-exploiting one area or by using it during a season when animals are bearing young or are nutritionally stressed. Such use is usually destructive of far more animals than just those that are killed by hunting.

  Such control is not exerted in the north because only a part of the hunting public is subject to law. Under provisions of the Yukon Act (Section 17) the Commissioner of the territory, i.e., the territorial government, cannot make regulations that restrict Indians in hunting for food on un-occupied crown land. Regardless of the rationale behind this, it reduces greatly the ability of the wildlife managers to protect sensitive wildlife areas, populations or species. Furthermore, it precludes any consistent method of evaluating such hunting. Beyond this, only about one or two per cent of all violators of the Game Ordinance are prosecuted for their deeds: the Yukon Wildlife Branch has only about 8 conservation officers for an area about one-half the size of Ontario!

Notwithstanding staff limits, a short period of activity by professional managers and disinterest by the public, the Yukon Wildlife Branch has established a territory-wide set of management units and about 400 sub-units. In general these units will be the basis of inventory and of all data recording processes. Currently, the Y.T.G. Wildlife Branch is attempting to develop inventories of wildlife in areas that receive the most use and attempting to institute a quota system on such units.

Inland fisheries management and protection are supported on a weaker base of staff and information than is the case with wildlife. Aside from a system of bag limits there is no control over freshwater fisheries harvest: areas near access may be overfished and there is no established system of control over commercial "fly-in" fishing operations. The only licencing that occurs is that which is imposed via land use regulations. These regulations control the construction of camps. If "fly-in" operations are to be a part of the Yukon recreational fishing business a system of control on number and distribution of camps, numbers of visitors or total take must be implemented to spread angling pressure and assure that the fish populations of the remote lakes are not abused.

There is, on the other hand, potential for low intensity fisheries for species such as whitefish and anadromous salmon, which species offer real management and development opportunities for production of specialty food products which could be sold locally. The basic idea behind such cottage industries is that they should be labour-intensive and produce a quality, specialty product, without requiring a large volume of fish. There would be a need to plan such operations carefully to minimize the development of conflicts between them and existing recreational activities.

A second important component of management is habitat enhancement, which may take many forms for both fish and wildlife. It is, however, dependent on an excellent knowledge of the life-history biology of the species, and in the case of such measures as fire enhancement of wildlife ranges, it also demands a sound understanding of the ecology of the forest or grassland system which is being manipulated.

A third important management component is two-way communication with all users. There must be enough staff available to be able to engage in such work and the attitude of the public has to be positive enough to allow the development of good dialogue. This

does not happen in many parts of the north. A few hunting and trapping groups are organized in some parts of Yukon; there is, however, only one small group which represents the interests of the non-hunting public. This type of representation should be expanded.

As has already been stressed, in the management of resources such as fish, wildlife or forests, it is essential that we understand them. This understanding is gained primarily through sound scientific research. Research activities in the north are inadequately supported. The Yukon Wildlife Branch has high quality biologists, but their members and support capabilities are very limited. The Canadian Wildlife Service, once a powerful and valuable research organization is fading away in the north.

The need for research in the arctic and sub-arctic has been stressed so repeatedly that it is almost trite to deal with it again. This point is made again in this paper notwithstanding the voluminous studies of specific areas carried out for the Mackenzie Valley Pipeline Inquiry. A quotation from the Science Council Report (1970), "This Land is Their Land," still appears justified:

> *It seems that arctic resources will soon be exploited without adequate background study of the natural environment. In consequence, there is every prospect that northern development will be accompanied by the creation of a new set of environmental problems which would have been far easier to avoid than to rectify.*

Within fisheries there are only a few people involved with management, protection and research on inland and anadromous fish from and including the Stikine drainage north. This is unfortunate in view of the fact that the Yukon River is considered to be the third most important salmon river in North America. It is of concern because a number of sites on the river are thought to be major potential power-dam locations. Such developments, without full and proper research, would destroy valuable salmon runs and would foreclose many options for salmon enhancement.

While this paper has already dealt with the management and research needs arising as a result of industrial development, it has not specifically looked at what these developments may be.

It must be pointed out that the basic policy of the Yukon government is one of encouraging virtually any form of industrial and economic growth. The proceedings of the various Northern Resources Conferences all indicate the very strong desire to develop mines, dams, roads, etc., shared by the territorial government and developers alike.

The Yukon Wildlife Branch listed potential development projects in the territory in 1978; some of these are in fact ongoing. They are as follows:

- Alaska Highway Gas Pipeline.
- Skakwak Project — highway construction and upgrading.
- Dempster Highway — completion and operation.
- Dempster lateral gas pipeline.
- Northern Canada Power Commission has selected primary sites at 11 locations.
- Gas, oil and mineral exploration.
- Mining developments, proposed or ongoing:

— MacMillan Pass — barite
— Mactung — tungsten
— Tom — lead/zinc
— Faro — in operation
— Tantalus Butte — Cypress Anvil — coal
— Canex placer — lead/zinc — at Howard's Pass
— Exploration roads and tote trails, extensively developed over much of Yukon.

Since 1978 placer exploration and development has boomed in Yukon; under present controls this is probably one of the most destructive and unfortunate types of activity where fish and wildlife habitat is concerned. The sparse populations of stream-dwelling fish throughout the territory are vulnerable to the water changes and siltation impacts of placer operations. While gold prices are high, in the light of environmental concern the usual rhetorical question is "What is a handful of grayling worth?"

Oil and gas exploration and development may lead to a deepwater port being constructed at King Point with an airport near to it. This would lead to a road to the port and a second road across the calving grounds of the Porcupine River caribou herd to Mt. Sedgewick for harbour construction material.

It is not possible to make this list comprehensive or final because new proposals are continually appearing, while some of the old ones fade into obscurity.

The reality is, however, that there are many potential developments. There is a strong desire by part of the Yukon public to have such development. Many of the developments that do come will give rise to new communities, or population expansion and a host of new pressures on fish and wildlife and their habitats. Reference is often made to the idea of balancing the development of renewable and non-renewable resources. Such a strategy would call for a firm statement that balance is to be achieved as a social goal. It would also call for a plan for its accomplishment. Neither exist. It is in fact questionable in our society if such a process could be accomplished as a matter of public choice.

Proposals to "integrate" resource uses do not necessarily imply any final balance between use of renewable and non-renewable resources. Planned integration can continue uni-directionally and with the blessings of government policy makers. It can continue one step at a time, continually reducing and/or impairing fish and wildlife habitat until there is very little left. In this type of process, where the over-riding social goals involve growth and development, planning is a more comfortable process for politicians and bureaucrats and may be a placebo for the public, but it will not guarantee the continued existence of fish, wildlife or their habitat. We must recognize this.

At present major policies regarding northern development of non-renewable resources are established in government offices thousands of miles off-site. Major decisions are made in board rooms in places as far away as Toronto, New York, London and Tokyo. This type of situation is acceptable to most southern Canadians and to developers in the north. It does not however, serve the interests of the caribou, falcons, grizzly bear, marten, etc.

There is need now for a national statement of goals and policies to protect the renewable resources base and the resources; such a statement should be powerful and sincere. The people who value these resources and use them must be integrally involved in the preparation of such a statement.

In view of the sensitivity of northern species, the low productivity of the land, the weak or outdated legislation and the strong government desire for growth and economic development I feel considerable pessimism for the future of many vital elements of the northern fish and wildlife resources.

Much hope may be with the indigenous people and the pressure that they can exert; in order to make real gains for wildlife, however they will have to recognize that simply owning the resource or having jurisdiction over it will profit no one if the existing land use goals, policies and legislation continue. If non-Indian residents of the north have few or no options to use wildlife, if they feel that they are second-class people with regard to its use, and if they are able to pursue non-renewable resource exploitation options under the present type of legislation and policies, they will be even less concerned about the effects of developments on fish and wildlife whose protection will be even more difficult to achieve. Ultimately, the indigenous people may find that they have bargained for an empty bag.

To offer some final philosophical comment; I believe that wild species have a right to exist for their own sake alone. This does not mean we cannot use them. It means we cannot destroy them.

I believe that the limits that we now find on resource availability in the south will soon extend to those in the north. Perhaps our challenge should not be to seek forever more resources but to find within ourselves the ability to exist in a state of harmony with what we have. We have been opening the land for 300 years to provide more jobs for more people. It is a fruitless spiral of effort in which we escalate the level of precariousness of our own environmental and resource situation. On the other hand, more and more people seek to see and enjoy wild creatures and wild places. It is clear that wildlife and wild places are part of the culture and heritage of the original North Americans. What is less clear perhaps is that they are part of the heritage and culture of all of us. Many people, native and non-native alike, share strong common interests. These should bind us as a people.

If enough people were to recognize these things we might say — "Let the north be." It is an area of incredible beauty and sensitivity. In the long run if the wildlife resource persists it may be sought to be seen and appreciated more than anything else in areas such as Yukon. In a future world of crowded cities and pressured people the incredible scenery of Yukon, its wildlife, its space, beauty and solitude may become its most priceless asset.

If the world is going to grow too much for anyone to be able to appreciate and afford such things, then it is unlikely that they in the north can save the situation by copying such folly. In this general context the things that we do, and have done to wildlife, must ultimately make us ask some fundamental questions about ourselves and our own destiny.

The future role and challenges for management of renewable resources such as fish, wildlife and their habitats are immense. They are social, moral, and technical. They go far beyond simply maintaining stocks for harvest.

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Appendix I. Preliminary List of Mammals[1] of Yukon with notes on status, distribution and abundance

Species	N of 60° and Yukon — major part of range	N of 60°, wide over Yukon and extensively south	Marginally into Yukon	Original range reduced sharply	International[2]	Yukon[3]	Numbers in Yukon[4]	Degree of management concern for species status[5]
UNGULATES								
Caribou, barren ground *Rangifer tarandus granti*	X					A	100,000	H
Caribou, woodland *Rangifer tarandus caribou*		X		X		A	5,000?	H
Moose *Alces alces*		X				A	30,000	L
Mule deer *Odocoileus hemionus*		X				R	300	L
Wapiti *Cervus elaphus*			X	X		RI	100	L
Dall sheep *Ovis dalli dalli*	X					A	18,000	M
Stone sheep *Ovis dalli stonei*		X				A	4,000	M
Mountain goat *Oreamnos americanus*		X		X		R	1,100	H

Appendix I (cont'd)

Species	N of 60° and Yukon — major part of range	N of 60°, wide over Yukon and extensively south	Marginally into Yukon	Original range reduced sharply	International[2]	Yukon[3]	Numbers in Yukon[4]	Degree of management concern for species status[5]
Muskox *Ovibos moschatus*	X		X			RI	10	L
Bison *Bison bison*				X		RI	0?	L
BEARS								
Polar bear *Ursus maritimus*	X		X		II	R	?	L
Grizzly bear *Ursus arctos*		X		X	II	A	6,000	H
Black bear *Ursus americanus*		X				A	?	L
CANIDS								
Wolf *Canis lupus*		X		X	II	A	?	M
Coyote *Canis latrans*				X		A		L
Fox, arctic *Alopex lagopus*	X		X			A	?	L
Fox, red *Vulpes vulpes*		X				A	?	L
CATS								
Cougar *Felis concolor*			X		II	R	few	L
Lynx *Lynx lynx*		X			II	A	?	L
MUSTELIDS								
Wolverine *Gulo gulo*		X		X		R	3,000	H

Appendix I (cont'd)

Species	N of 60° and Yukon — major part of range	N of 60°, wide over Yukon and extensively south	Marginally into Yukon	Original range reduced sharply	International[2]	Yukon[3]	Numbers in Yukon[4]	Degree of management concern for species status[5]
Fisher			X	X		R	few	L
Martes pennanti								
Otter		X		X	II	A	?	L
Lutra canadensis								
Marten		X		X		A	?	H
Martes americana								
Mink		X				A	?	L
Mustela vison								
Ermine		X				A	?	L
Mustela erminea								
Least weasel		X				A	?	L
Mustela nivalis								
HARES and PIKAS								
Pika		X				?	?	L
Ochotona princeps								
Snowshoe hare		X				A	?	L
Lepus americanus								
RODENTS								
Beaver		X				A	?	L
Castor canadensis								
Muskrat		X				A	?	L
Ondatra zibethicus								
Hoary marmot		X				R	?	L
Marmota caligata								
Woodchuck		X				R	?	L
Marmota monax								
Porcupine		X				A	?	L
Erethizon dorsatum								
Bushy-tailed wood rat		X				?	?	L
Neotoma cinerea								
Red squirrel		X				A	?	L
Tamiasciurus hudsonicus								

Species	N of 60° and Yukon — major part of range	N of 60°, wide over Yukon and extensively south	Marginally into Yukon	Original range reduced sharply	International[2]	Yukon[3]	Numbers in Yukon[4]	Degree of management concern for species status[5]
Least chipmunk *Eutamias minimus*		X				?	?	L
Northern flying squirrel *Glaucomys sabrinus*		X				?	?	L
Arctic ground squirrel *Spermophilus parryii*						?	?	L

NOTES: (1) A further 22 species of small mammal, listed in Hartman and Hayes 1980, have been omitted from this Table.

(2) The numbers I and II indicate that the species is listed in either Appendix I or II of the Control List (1978) of the Convention of International Trade in Endangered Species of Wild Flora and Fauna (CITES).

(3) A — abundant, R — rare, I — introduced.

(4) All numbers, except for sheep and goats, are very approximate estimates.

(5) H — high, M — medium, L — low concern.

Appendix II. A list of Yukon fishes with notes on extent of distribution, and use for food, recreation and sale

Species	Occurrence[1]	Use[2]
Arctic lamprey	N	L
Inconnu	Ex	M R F
Lake whitefish	Ex	M F C
Broad whitefish	Ex	M F C
Least cisco	Ex	L F
Arctic cisco	N	L F
Round whitefish	Ex	L F
Mountain whitefish	S	L F R
Pygmy whitefish	S	L
Arctic grayling	Ex	H F R
Lake trout	S & C	H F R C
Arctic char	N	L F R
Dolly varden	S	M F R
Rainbow trout	S	L F R
Chinook salmon	Ex	H F R C
Coho salmon	S(N?)	L F R
Chum salmon	Ex	H F C
Pink salmon	S	L F
Kokanee — sockeye salmon	S	M F R
Boreal smelt	N	L
Northern pike	Ex	H F R
Flathead chub	N	L F
Lake chub	Ex	L
Longnose dace	N&S	L
White sucker	S	L F
Longnose sucker	Ex	M F
Trout perch	N	L
Ling (Burbot)	C&S	M F R
Ninespine stickleback	N	L
Deepwater sculpin	N	L
Slimy sculpin	Ex	L

NOTES: (1) N — north, C — central, S — south, Ex — extensive.
(2) H — high, M — medium, L — low/nil; F — food, R — recreation, C — sale.

SUSTENANCE OR RECREATION? The Future of Native Wildlife Harvesting in Northern Canada

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The problem that most directly confronts resource managers is the harmonization of the supply of a resource with the demand placed upon it. In some cases, resource managers can increase supply in order to meet demand. In others, because they are largely unable to control supply, their basic task is to regulate demand. Those who manage fish and wildlife resources in the North are essentially in the latter category. As a consequence, although they are certainly armed with a body of scientific description and analysis of the resource, what they actually manage or manipulate is, for the most part, not the resource but the efforts of the people who harvest it. (Predator control is the major exception).

The business of equating supply and demand generally begins with a series of numerical questions. How many or how much do we have, or can we expect, and how many people want it and in what quantities? If supply exceeds demand, managers may be faced with the problem of stimulating harvesting effort. But in the North, fish and wildlife managers more usually believe that demand exceeds supply. Their next task then, is to determine the most effective or expedient way of restricting demand, usually through the imposition of licencing requirements, seasons, quotas, and gear limits, as well as restrictions on possession and trafficking.

We do not, however, very often think about why demand arises in the first place, what the nature of that demand is, and what ends it serves. Yet if we do not understand why people want things, we may formulate our questions incorrectly or imprecisely about how much they want, and we may very well fail to devise effective strategies for limiting demand or effort. To pose the question "sustenance or recreation?" is not to ask how much (at least not to begin with), it is rather to ask "what for?".

Today I want to examine the way we conventionally approach this question, and to propose some alternative approaches. I will argue that for most Native people wildlife harvesting is indeed a matter of sustenance because it is central to their mode of production, and then explain some of the implications of my analysis for wildlife management. I will then outline the factors which I think will significantly affect Native demand in the future, and finally propose some potential solutions.

Some Paradigms

Discussions of Native wildlife harvesting are almost invariably informed by two paradigms, the first of which purports to explain the persistence and function of hunting in our time, and the second, the behaviour of hunters. So widely held are these paradigms that most people who use them feel no need to justify or explain. They have become, in effect, conventional wisdom.

The first derives from a widely accepted evolutionary theory of social development, which sees hunting as an early or primitive stage in that process. Societies which have evolved to higher levels, and are based on agricultural or industrial systems of production, have freed themselves from the economic necessity of hunting. The more "modern" a society is (which is to say, among other things, the more pervasively and effectively is its economic activity dominated by large organizations) the more hunting, however primordial or instinctive a cultural impulse, is believed to have become merely a recreational or "lifestyle" preference. It follows that once a small, primitive society becomes, through contact with a large industrial one, acculturated and modernized, hunting is reduced to a mere cultural legacy, or recreational pursuit, because the widespread availability of wage labour, transfer payments and imported substitutes have now displaced the economic importance of hunting.

The second paradigm views hunter behaviour in terms of a biological predator-prey relationship, essentially uninformed by cultural characteristics (save perhaps greed and ignorance). The aboriginal hunter is seen as a predator at the top of the food chain. Subject to biological cycles, natural catastrophes, periodic starvation and internecine skirmishes, armed only with arrows and harpoons, his mobility assisted only, on occasion, by animal traction, he was subject to the classical laws of diminishing returns on effort. With rare exceptions, hunting populations could exist indefinitely in balance with their prey, but only by virtue of natural laws. No indigenous cultural mechanisms for control or management are acknowledged to have been at work. As soon, then, as the primitive hunter is given the least advantage over his quarry, for example by virtue of traps, nets, explosives and engines, the natural limits on hunting effort are removed, and he will eventually destroy the very resources on which he must reply. The native hunter must, therefore, as soon as he acquires this modern technology, be regulated in his activities, for his own good as well as that of others. Many believe that the only sound basis for such harvesting regulation is scientific management.

Lest it be thought that I am setting up straw men, two recent articulations of these paradigms (or parts of them) by leading wildlife scientists and managers may be found in papers by Mitchell and Reeves (1980) on the bowhead controversy in Alaska, and by Macpherson and Brooks (1981) on wildlife management in northern Canada and Alaska.

The longer I have studied native wildlife use in the North, the less helpful I have found these paradigms to be. I do not dismiss them as being simply wrong, but I think they fail to explain many of the things we observe. Too frequently, they are invoked, by social as well as wildlife scientists, in an ahistoric and imprecise manner, indeed they are invoked as facts instead of as hypotheses to be tested against the circumstances in question. I call attention to this misuse not to suggest that wildlife scientists steer clear of social scientists' territory, but on the contrary, to invite them to explore it more fully.

There are, fortunately, alternative paradigms. The first concerns the nature of social evolution and change. In contrast to prevailing evolutionary theory, which focusses on energy, technology, and material culture as the hallmarks of change and progress, the alternative paradigm suggests that major changes in human history are marked chiefly by changes in the *mode of production*, a concept which incorporates not simply the forces of production (land, labour, technology and capital), but also the relations of production, which is to say, the social organization of productive activity and the values and beliefs which serve to perpetuate it. The major epochs of human history are marked by a particular mode of production becoming dominant but, importantly, not exclusive. This situation

results not in uniformity of development, but in inequality of development. In our time and place, the capitalist mode of production is dominant, but there are others that survive and in some cases even flourish, in consequence not of their isolation from the capitalist mode, but rather from their articulation with and dependence upon it.

Modern capitalist production, in its most advanced manifestation, is performed by large and highly structured social organizations, which we call corporations. Not all goods and services, however, are most effectively produced by these large and sophisticated units. For example, where a resource is geographically dispersed and its harvest requires neither elaborate social organization nor sophisticated techniques (as distinguished from individual skills), there is neither need nor incentive for corporate enterprise to be involved. Such is the nature of hunting, trapping, and inshore and inland fishing in the Arctic and subarctic. Like many other economic activities, they are more effectively performed by small productive units, mostly organized at the level of the household, although occasionally such forms as the small owner-operated firm may appear. All function in a market environment, as opposed to the planning environment in which Galbraith (1973) suggests that large corporations operate. Capitalist relations of exchange thus prevail, except insofar as there is domestic consumption of the product, which in the case of household harvesting of fish and wildlife, is considerable.

An additional feature of this paradigm is that forms of production effected by large organizations tend to be economically and politically dominant, as well as centrally controlled. Those forms that remain open to small units of production, and especially to the household, tend to be socially and economically marginal, and often geographically peripheral. They are, accordingly, highly vulnerable to initiatives from the centre, and must react and respond to these. Due to the uneven nature of the development process, core-periphery relations tend to become entrenched and perpetuated, and the boundaries between the two become less able and less likely to be crossed, at least by those on the periphery.

The problem with the second paradigm, which describes hunter behaviour in terms of a biological predator-prey relationship, is that it ignores a substantial body of anthropological evidence which suggests that this analogue is incorrect. There are two reasons why this is so, the first of which is closely related to mode of production theory.

The real limits on production, it seems, may be organizational rather than technological. That is, there is a tendency for both resources and labour to be underutilized in a domestic mode of production, because so long as production for use value rather than for exchange value prevails, demand is relatively inelastic (for a comprehensive discussion on this point, see Sahlins 1972:41-99). There is evidence from hunting societies in many parts of the world that time spent in productive activities is relatively low (Sahlins 1972:11-28). (This fails to support the popular notion that hunters live so close to the edge of scarcity that they must spend every waking moment scrambling for their next mouthful). The observation that snowmobiles, when adopted by trappers on Banks Island, N.W.T., served to increase leisure time rather than fur production (Usher 1972) is consistent with these findings.

The second reason is that native hunting regimes have been identified in which social and religious practices have served, in fact if not in direct intent, to conserve essential resources. An example is the James Bay Cree of Quebec (Berkes 1977; Feit 1973). And certainly, every native society has a body of customary law governing the allocation and

use of resources. That few have been committed to writing, as is the case with the Elders' Rules in Labrador (Brice-Bennett 1977b:165-171; Brody 1977:325-330), is not a refutation of their existence.

It would be wrong to use these paradigms to suggest that native people never overharvest, or that they are "natural" conservationists. Nor indeed should these paradigms be taken as a new form of received truth with which to replace the old. What I have tried to demonstrate is that the social sciences have not produced straightforward answers to these questions on which all agreed. Consequently, scientific wildlife management which assumes that there are obvious, straightforward laws about "human nature", and that ethnographic detail serves only to illustrate their universality across the spectrum of human societies, is not in fact scientific, and perhaps more important, will probably not work.

The alternative paradigms I have outlined invite us to be extremely rigorous in specifying the conditions under which certain assumptions or hypotheses apply. They also invite us to try to identify the socio-economic circumstances which are most conducive to achieving the goal we all share, which is the conservation of environments and species for the perpetual benefit of those who depend on them.

Some Implications

The first paradigm — evolution/acculturation theory — suggests that for native northerners, hunting in the modern day is no longer (or soon will not be) an essential feature of life. It may be an important cultural legacy, but its objective function is recreational. Few who invoke this paradigm any longer deny the economic and nutritional importance of country food to native northerners, which fact has been widely documented in recent years. They might, however, argue that the task of modernization (essentially the creation of a secure and stable order based on industrial production) with respect to offering alternatives to these commodities is merely greater than had been expected. They would, in answering my opening question, come down rather heavily on the side of recreation, if not now, then within a future for which we should already be planning.

I believe, in contrast, that hunting, fishing and trapping by native northerners is not simply a relic of earlier times, and that its persistence need not be explained in terms of primeval impulses. I submit that these activities are rational adaptations of marginalized people in the periphery, who although they themselves may explain their need for fish and wildlife in cultural and historic terms, will in fact intensify their reliance on these resources for very practical reasons related to their contemporary socio-economic circumstances. Important though the economic and nutritional reliance on fish and wildlife is and will continue to be, these resources are also sustenance to native northerners in the larger sense that they provide the means for at once adapting to and resisting forces beyond their control. Let me elaborate, drawing on the alternative paradigms outlined above.

Until hunting, fishing and trapping are amenable to substantially more complex forms of productive organization (and I expect none of us can foresee such a day), and so long as the marginal situation of native northerners vis-à-vis the corporate or modern economy persists, then these activities will persist in much their present form. By marginal, I mean that despite the achievements of occasional individuals, native northerners as a group do not effectively control the rate and direction of economic activity in the modern industrial sector, and do not strongly identify with its objectives, despite their participation in it as wage labourers. Renewable resource harvesting will continue to be organized at the

household level of production, save possibly in some of the larger commercial fisheries or where rudimentary forms of husbandry are involved, as in reindeer herding or fur ranching. This in no way precludes the continuing improvement in harvesting technology, although there may be certain economic limits to that process (Riewe 1976:640-42).

This suggests that hunting, fishing and trapping will persist regardless of how much "modern" activity is occurring in geographic proximity (except insofar as the latter may result in the damage, disappearance or destruction of fish and wildlife resources in particular areas). So long as northern regions remain marginal (and again, I expect none of us can foresee a change in that situation), then regardless of the availability of alternative income and imported substitutes, the traditional harvesters of fur, fish and game will continue to regard these resources as important and even essential to their long-term security, their cultural identity, their socio-economic status, and their general well-being. No amount of "modernization", so long as the local population is marginal to it, will induce a voluntary abandonment of traditional activities. Some individuals may choose not to participate, others may for economic reasons be forced out of this mode of production, but a significant element will cling to it just as is the case with small farmers or fishermen who, as small-scale primary producers find themselves in a similar situation.

Also crucial to the persistence of hunting, fishing and trapping are more or less favourable terms of trade. Assuming there is a primary orientation to hunting and fishing for domestic consumption and for social and cultural purposes, then either high commodity prices or high wage rates (relative to the demand for imported essentials and particularly for productive equipment), will serve to perpetuate hunting and fishing activities. Contrary to the idea that trapping or commercial fishing is "primitive" and "unproductive", while working for wages is "modern", the native hunter is more likely to see the choice in opportunistic terms. That is, other things being equal, he will engage in which ever activity brings the greatest return for the least effort. That a considerable capital investment is required to maintain a hunting outfit is accepted as a priority demand on income, regardless of source. The maintenance of such an outfit provides, in most cases, the basis not only for cash-earning activities such as trapping and fishing but also for the reaping of domestic income from the hunt. So long as there is substantial overlap between these cash and domestic functions, there is little impediment to seasonal or periodic shifts between trapping, fishing and wage employment. It is when large investments are required for highly specialized harvesting activities that the articulation of the traditional mode with the capitalist mode becomes, at the individual level, more difficult.

Time being a critical and limited factor, it will be seen that wage employment which imposes an inflexible working schedule or provides inadequate income will, because of its rendering domestic hunting and fishing impossible, not be attractive. It follows that within certain limits, employment in such high-paying activities as oil and gas exploration can serve to promote rather than diminish participation in hunting, fishing and trapping.

The possibility arises that the dominant mode of production would not be simply indifferent to the traditional mode, but might view its maintenance positively under certain circumstances. If the traditional mode provided a substantial real income on a predictable basis, without unduly interfering in the operation of the capitalist mode, employers could offer lower wages and benefits and be required to provide less employee infrastructure and security on the grounds that these needs were already met, in part at least, by the domestic economy. This situation is more likely to occur in more densely populated areas with more productive domestic economies (see Hailey, cited in Prattis, 1980:311, on migrant labour

in Africa). I do not foresee this outcome as likely in northern Canada in the foreseeable future.

A more likely possibility, however, is that as hunting, fishing and trapping employ more advanced technology and require greater capital investments, certain manufacturers and distributors will have a growing interest in the perpetuation of these activities. Although I am aware of no recent comprehensive studies in this regard, it would appear that native northerners tend to spend a considerable proportion of their cash incomes on harvest related equipment, and further, that this demand is elastic in the sense that where incomes increase, more and better equipment is purchased.

It can sometimes be demonstrated (using a sufficiently reductionist approach) that the continued harvest of any particular species is not nutritionally, economically, materially or ceremonially "necessary" to a particular group of people (see, for example, Mitchell and Reeves 1980). It can, on the other hand, readily be shown that both nutritionally and economically, the harvesting of fur, fish and game in general is of very great importance to most northern native peoples (see, for example, Berger 1977a, b; Berkes and Farkas 1978; Usher 1978). Yet a consideration of nutritional and economic well-being alone is also somewhat reductionist. The relationship between traditional resources and social organization is also important.

Indeed, a crucial test of the significance of wildlife harvesting to any group is the extent to which that activity is central to reproducing its social relations of production, for example, through the socialization of children, mutual aid and sharing, and the reinforcement of stewardship and use arrangements with respect to land and resources. A recent unpublished paper by Wenzel (n.d.) documents the way in which polar bear hunting currently performs these functions among the Inuit of the High Arctic. It has been shown, moreover, that the loss of a part of the resource harvesting complex, even where there is a corresponding rise in wages and welfare, can result in the remaining traditional activities assuming an even more central role in serving these purposes (Usher et al. n.d.). These findings are at odds with the conventional notions of acculturation which suggest that allegiance to traditional activities is progressively sloughed off as "modernization" increases.

A corollary of the above is that what is important about wildlife to native people is not simply that it is of cultural or aesthetic importance, but that it is the obvious, and indeed the only possible basis, in the Arctic and subarctic, for the maintenance of the social relations that characterize the traditional mode. It is the relations among people that wildlife harvesting generates, not simply the relations between man and wildlife, which are important.

The idea that any type of employment, so long as it is outdoors and involves fish and wildlife, will be especially suited to native people, ignores this essential fact. For example, working on large trawlers in an offshore fishery is not intrinsically more interesting or beneficial to native people than working on offshore oil rigs. Both are forms of industrial employment, involving capitalist relations of production. In the same way, the idea that native people might be especially interested in becoming wildlife scientists or managers, or tourist operators (e.g. Lotz 1970), is also without solid foundation. The social relations of production in a bureaucracy or even in a small business are not the same as those in the traditional mode.

I am not suggesting that it is impossible, or even necessarily undesirable, to shift allegiance from one mode of production to another. Obviously many people do in fact make that shift. Rather, I am suggesting that native people (like other people) have a greater allegiance to a mode of production as a whole than to some particular feature of it — in this case, to a social system based on fish and wildlife harvesting than to a love of fish and wildlife per se. Consequently their reasons for moving from one mode of production to another are not likely to centre on the material or metaphysical qualities of the resource base itself.

The centrality of fish and wildlife to native people is thus a function more of the core nature of the social and economic system than of culture and tradition. This explains why some commonly held non-native perceptions about how native people "should" hunt and fish appear ridiculous or irrelevant to native people themselves. If hunting were merely a cultural predilection, then it would make sense to insist that people pursue it according to tradition, using spears, kayaks and dog teams. It would make sense to lament, and even to outlaw, the use of airplanes and snowmobiles. If hunting is seen in contemporary social terms, however, and as a viable economic pursuit, it becomes no more appropriate to restrict hunters and trappers to an archaic technology than to so restrict farmers or loggers. Gear restrictions can only be justified in the name of conservation of the resource.

By the same token, conventional distinctions between domestic and commercial harvesting must be modified where necessary to take account of changing social forms. Inflexible and doctrinaire approaches to this issue may or may not result in technical violations of Native rights, but they certainly result in an acutely perceived interference with deep-rooted social relations and obligations among native people.

Native Demand for Wildlife

What I am predicting is a future in which hunting, fishing and trapping, although greatly transformed in their technical and cultural manifestations, will continue to play a central role in the economic and social life of large numbers of native peoples in northern Canada. It is, however, precisely the elements of those activities most celebrated by ethnographers and romantics which will disappear, if they have not done so already. The items of material culture used for and derived from these activities will be less and less distinguishable from those of non-natives. Ceremonial elements of the hunt will atrophy, and the highly specialized (and admired) traditional skills are likely also to decline, since modern technology will generally enable the less specialized hunter to obtain resources in adequate quantities to make his efforts worthwhile. He will become an effective, although less efficient, harvester, because he will use (and waste) more energy per unit of harvest. (In this respect he will, of course, resemble most other producers in industrial society).

Casual observers will, as they already do, interpret these events not as a transformation but as an absolute decline of the role of hunting, fishing and trapping in native life. They will conclude that fish and wildlife are no longer "necessary" to native people, because as a result of modernization they will have lost the essential elements of their culture. In fact, however, fur, fish and game will continue to be essential resources for both economic and social reasons in the livelihood of many native northerners, for reasons not of ethnicity, nor even primarily of culture, but of class. Those native people who effectively integrate into the business, managerial and professional streams of society (and they may become a not insignificant group), will not have the same socio-economic need of the resource. For them, wildlife may indeed become a matter of recreation, not sustenance.

The matter of population-resource balance is of great and legitimate concern to wildlife managers as well as to many others. Many observers have held that the renewable resources of the North cannot support the population there because of the latter's growth in numbers and its rising economic aspirations. Whether stridently asserted (e.g. Legislative Assembly of the N.W.T., n.d.; Stabler and Olfert 1980:383), or thoughtfully expressed on the basis of considerable research experience (e.g. Fuller 1978:449; Bliss 1978a:31-32, 1978b:34-37), this proposition has not been supported by adequate data. By the same token, more optimistic views of the population-resource balance (e.g. Berger 1977a, b; Usher 1978) have also been deficient in this respect.

The recent findings of the Science Advisory Board of the N.W.T. (1980), and the supporting documents (McCart and Den Beste 1979; Dickinson and Herman 1979; Davis et al 1980) are thus welcome and timely additions to our consideration of the supply side of the equation. Fuller and Hubert, in summarizing this research for the present symposium, suggest that at the present level of per capita demand, production could be increased to satisfy about double the present population of the North, but caution that this doubling could occur in only twenty years time.

Although population projections are useful (e.g. Hamelin 1979, also for the Science Advisory Board), I do not think it is adequate simply to count bodies or to assume a constant level of per capita demand. Effective demand for wildlife cannot be directly equated with the number of people in the North, nor even the number of native people there. Effective demand will be much more a function of the kind of society and economy that develops there, and as I have already suggested, there will be no single economy and society but a complex of differing modes. The prediction of demand will therefore depend on a variety of factors, many of which are not readily forecast on the basis of casual observation or "common sense", if indeed they can be forecast at all.

Fifteen and twenty years ago, most of us subscribed to the notion that because most people were, or would be shortly, abandoning their traditional activities, demand would as a consequence be declining. We were wrong. Let us not now make the opposite error of assuming virtually unchecked demand as a consequence of growing populations, unrestricted entitlement, rising expectations and sophisticated technology.

What, then, are the factors which might affect native demand for fish and wildlife? The mode of production to which people adhere will obviously be very important. Unfortunately we do not have any precise measures of the proportion of native people currently adhering to the traditional mode, or what the trend will be. We can hypothesize that an approximate measure of this adherence is the distribution of the population by settlement type or function. It seems likely that the urbanized fraction of the native population (to the extent that that is a more or less permanent phenomenon) would have a substantially different attachment to the mode of production than those in the smaller settlements, and that the demand for wildlife resources would be both qualitatively and quantitatively different. To my knowledge, however, no research is underway to test this hypothesis.

We do know that a growing proportion of the native population in the territories resides in large regional centres, such as Frobisher Bay, Yellowknife, Inuvik and Whitehorse. We do not know how much of this faster growth is accounted for by higher rates of natural increase as opposed to net immigration from the smaller centres. Although there has been an extensive documentation of the use of land and resources by native northerners residing

in the smaller, more traditional communities, there is no parallel information relating to the substantial numbers of Native people who reside in the larger centres. We do not know how permanent their residence in and attachment to these larger centres are, and we do not know the extent to which these people actually harvest fur, fish and game, much less the trends. We do not know the extent to which the children born and raised in these centres are divorced from the traditional mode, and to what mode they will gravitate in later life.

Yet this growing urban-village differentiation among Native people, if a fact, suggests some important possible developments. One is the growth of intersettlement trade and a trend towards commercial harvesting. Reduced involvement in actual harvesting by urban native people might be counterbalanced by their continuing demand for country food, which could be met by trade or purchase. To the extent that this demand provides an outlet for unharvested species or unutilized byproducts in the producing areas (for example, marine oils and meats), this, as well as the income and employment generated, would be a benefit to all. On the other hand, it could lead to an intensified demand for already scarce resources.

The potential for native northerners to be self-sufficient in protein for at least the next couple of decades depends in part on a demand mix compatible with the actual abundance of the various food species. It will not be realized if caribou and moose are harvested to the neglect of rabbits and fish, or to the waste of beaver and seal meat. Geographical dispersion of hunting effort, in accordance with actual game abundance, will also be necessary. The location of the population, the kinds of media and educational influences which suggest what are good and bad foods (i.e. modern and clean foods as opposed to "primitive" and smelly ones), and public health policies that affect which species can more easily or economically be harvested, processed and distributed in accordance with southern norms of food hygiene, will all affect demand levels. Thus game management strategies cannot be seen in isolation from social, economic, and public health policies.

Quite apart from the urban-village distribution of the native population, will be factors affecting demand in the villages themselves. The extent to which local secondary industries based on renewable resources, such as tanning and food processing, are actually established in the small communities, will affect demand. Such industries offer many potential social and economic benefits, but on the other hand, by virtue of the capital investment they require, and the dependence on wage employment they create, demand a regularity of raw material supply that may not always be realizable (or consistent with conservation), especially in the case of resources which are only cyclically or periodically abundant.

Demand will be affected by changes in technology and in the mix of economic activity. Where life on the land was once a seamless web in which each activity at every season was part of a coherent whole, and in which a broad mix of resources was harvested, native harvesting now tends to be less coherent and more opportunistic. It is now both possible and feasible to hunt for ivory or pelts but not for flesh, and for flesh but not for organs or fat. Some byproducts which were formerly used are now often left to rot.

Whether or not urban natives will create a demand for country food, native people in the smaller settlements will more and more likely seek outlets for what they perceive as surplus produce, either through intersettlement trade or through commerce. As suggested above, this could either alleviate or aggravate the situation. I suspect that in the case of

country food (as opposed to furs and skins), increased and improved circulation through trade and commerce will more likely be beneficial if it remains within the native population, and will more likely be harmful if either sales to non-native northerners, or exports to southern regions, are promoted.

There is also the question of whether allocation policies, as determined either by wildlife managers or by the growth of secondary activity, will tend to favour specialized harvesting. Our economic system generally encourages specialization. If everybody does what he or she is best at, or has the greatest comparative advantage in doing, then, so the theory goes, efficiency will be ensured and everyone will prosper. This view is likely to inform the development strategies not only of resource managers, but also of economic advisors to governments, private investors, and native development corporations.

Yet it is this dogma that traditional native economic activity most offends. Instead of a few prosperous trappers or fishermen, we find many "poor" ones. Neoclassical economics has great difficulty in comprehending a mixed economy in which people do a lot of seasonal work and gain their livelihood from a wide range of sources. Such an unspecialized economy is seen as inefficient and unproductive. Yet, by virtue of both the nature of most fish and wildlife resources in the north, and the socio-economic relations of their production, as described earlier in this presentation, the existing pattern is often the most efficient and effective one in the end. The instances in which wildlife harvesting can generate consistently high cash incomes to individuals are few. Fox trapping on Banks Island is often cited as an example, but the circumstances there are exceptional. It does not necessarily follow that applying the Banks Island system to fox trapping elsewhere would be a recipe for generating similarly high individual incomes all across the Arctic.

While an economist might think that an average income of $10,000 to ten trappers is preferable to an average of $500 to 200 trappers, native people do not seem to agree. The $500 might be a very useful sum of money at the time it is received, and it might also represent a high return for actual time expended. As well, time and cost expenditures must be compared not simply to this cash income, but also to the domestic income generated in the same context. It should surprise no one that efforts to depart from the principle of universal access to resources by those involved in the traditional mode are commonly met with strenuous resistance.

The way in which native claims are settled will affect demand in two important ways. One is the model of economic development implicit in any particular settlement package. Those models which promote (or leave no viable alternative to) non-renewable resource development, the generation of income through finance rather than production, the growth of small business ("native capitalism"), and a widespread shift from the traditional to the industrial mode of production, will obviously encourage native people to view wildlife as a commodity, and to behave accordingly. There are, of course, many other pressures which so encourage native people, but the nature of a claims settlement could do much to hasten or delay or even reverse this process.

Secondly, the question of entitlement to native hunting rights will affect both the nature and the absolute level of native demand. The fear has been expressed that by entrenching special hunting rights in perpetuity to a rapidly growing population, without adequate restrictions, a virtually open-ended spiral of demand for wildlife resources will be created. Yet these resources cannot possibly increase in abundance at the same rate, if indeed they can increase at all. Again I would stress that the issue is not simply the number of bodies.

Where will these people live, and to what mode of production will they adhere? Whether wildlife is sustenance or recreation to them is not a question of genetics, it is one of social and economic status. I will propose below a means of dealing with the question of unlimited entitlement.

These, then, are some of the parameters affecting future demand for fish and wildlife resources by native people. I have not made any attempt to forecast actual levels of demand, because there are so few data or research results on most of these matters, or because these factors are by their nature not amenable to quantitative forecasting.

There is one parameter often used to forecast demand which I have not mentioned so far, and that is past demand. Estimates of past demand are normally based on data series which purport to approximate actual harvests. I have commented on the general inadequacy of these statistics at length elsewhere with respect to the Yukon (Usher 1979), N.W.T. (Usher 1975, see also Berger 1977b:9-13), and Labrador (Usher 1980:88-91).

Despite a growing awareness of the problem on the part of both territorial wildlife agencies, the situation is only marginally improving, and in some instances actually deteriorating. In the N.W.T., the decentralization of wildlife administration has apparently resulted in a situation in which in some districts at least, recent harvest data for some big game species are not simply unreliable, they are to all intents and purposes nonexistent. This is particularly unfortunate as the N.W.T. once had what were probably the most comprehensive and reliable statistics of any Canadian jurisdiction.

The difficulty of establishing a valid system in modern circumstances are considerable. It would appear that the recording systems in James Bay and Northern Quebec, developed in the context of the claims settlement there, merit serious study and, perhaps, emulation. It is widely recognized that reliable reporting can only occur in a climate of mutual trust between managers and harvesters. Management predictions of demand trends based on harvest data which are of such uncertain validity can hardly be credible to others, or lead to the necessary climate of trust.

Some Practical Suggestions

What does all this tell us about what might be done, in a practical way, with respect to wildlife management and native hunting rights? Unfortunately, my analysis is not easily translated into the conventional legal framework. I have suggested that socio-economic status is at least if not more important than ethnicity or culture in determining whether wildlife is a sustaining or recreational resource to native people. Yet there are no legal definitions of class in a liberal democratic society. Special access to wildlife resources by native people in Canada has always been recognized on the basis of ethnic status.

Need, in an economic sense, can be legally defined according to certain criteria, and that indeed is how many social and economic benefits are allocated in our society. In Alaska, that is partly the basis of the subsistence hunting regime. Indeed it would be illegal there to allocate resources on the basis of ethnic status. These purely economic criteria obscure important social distinctions which are also the basis of class. Conventional economic determinations of need carry a certain social stigma, and also deny ethnic and cultural elements of self-identification which native people obviously consider important. They would resist anything like a means test as a criterion of eligibility for harvesting rights.

and at the same time, would fear that criteria based on subsistence or class alone would open the door to non-native access of unforeseeable magnitude.

A solution may lie in the most central aspects of the social relations of the traditional mode: the system of land use, and the regime of customary law. Implicit in the traditional mode of production is a distinct and recognized geographical territory in which harvesting activities occur. The boundaries may change over time, and there may be overlap with other groups, but the customs and rules which govern land use are understood by all. No hunting group was without a known and bounded territory, in which insiders could hunt automatically, by virtue of their membership in the group, and outsiders might by permission gain access for specific purposes. Recent studies have identified these territories for much of northern Canada, and demonstrated their continuing significance (e.g. Freeman 1976; Brice-Bennett 1977a).

In popular thought, the importance of traditional native land use is now seen as the key to native struggles for a fair deal in a modern developing north — the native claims issue. Yet this traditional land use system also, however, provides an important means of conserving fish and wildlife resources, as many social scientists believe it did in the past. Many of the traditional hunting areas in the North are now identified with individual native communities. The populations which settled in the trading and administrative centres a generation ago were often, although by no means always, or exclusively, congregations of one particular group with an identifiable land base. One of the causes of overharvesting, as well as of the destabilization of the traditional system, is that lands which were once by customary law closed to outsiders, are now by territorial law open, with restrictions applying only on the basis of territorial residence or ethnic status. (The exception is trapping areas. In the Yukon, most are individually registered, the rest are group registered; in the N.W.T. there are some group registered areas, and a few individually registered ones, but most lands are open to all qualified licence holders.) The game laws, with few exceptions, do not restrict native hunters to their traditional territories (although the system of game management zones, based more on ecological than historical considerations, may serve to exclude hunters from certain areas at certain times). Until recently, this has been of little consequence, but the growing mobility of hunters due to snowmobiles, roads and aircraft, has opened up areas to native hunters, and especially urban native hunters, with no traditional rights in those areas.

There is a sentiment among many village natives that their traditional hunting territories should be reserved for their own group, and not be open to all other natives regardless of origin or current residence. Some claims settlements may insist on such changes, others do not. Yet geographical restrictions on hunting could also be effected by the re-establishment of customary law with respect to game. Such restrictions would, I believe, lead to a more limited demand on resources, and provide a necessary basis for their conservation by harvesters. It is therefore unfortunate that the mobility clause in the government's constitutional proposals will make more difficult the achievement of such goals.

Does native customary law have any relevance in the present day? Most game managers are probably either ignorant of customary law regarding the use of wildife, or believe that it has become outmoded and no longer operates effectively under modern circumstances. This view is held with perhaps even greater conviction by most non-native game users in the North. It may even be shared by some native people. It is a view that strongly informs non-native opposition to the idea that native people should manage their own resources.

As well, civil authorities are normally quite unwilling to countenance what they see as the exercise of regulatory authority by private citizens. Our prevailing notions of law and government make it very easy to dismiss the idea of elevating local custom to anything like legal authority.

Yet at the same time, many game managers see the futility of trying to impose a system of management and enforcement which the majority of harvesters do not acknowledge as legitimate, necessary or useful. Many recognize that where there are rights, there should also be responsibilities, and that the user group should have some substantial responsibility for the well-being of the resource, and accept the consequences of failing to exercise that responsibility effectively.

Instead, then, of dismissing native customary law as ineffective, and instead of denying it any legitimate role even if it were effective, should we not at least attempt to do two things?

The first would be to encourage native people to think about the applicability of customary law to current problems. That a body of law is referred to as customary does not mean it is necessarily antiquated or immutable. Our own legal system is always being modified and updated, slow and painful as the process often appears to be. In Israeli society, ancient talmudic laws are constantly reinterpreted to provide the guidance necessary to live a righteous life in a modern society.

The atrophy of customary law is not a function of its intrinsic inability to cope with change, rather it is a consequence of deliberate suppression. Too often, among native people today, customary law is celebrated only in the minds of the elders as something that worked well long ago. The challenge to native communities now is to seek the guidance of the elders, and the cooperation of the young, in order to make customary law relevant again. What does customary law have to say about the use of airplanes and snowmobiles, and about intersettlement trade or commercial fishing? And how would these laws be enforced? Surely it is in the interest of wildlife managers to find out, by encouraging and supporting this process, and by assisting in it if asked. And surely it is a process which will only work if there is some promise of a tangible result — some impact on the management regime, not simply a cultural history project.

Consequently the second thing would be to consider how customary law can be effectively melded with the exercise of state authority, instead of being dismissed as inconsistent with it. There are lawyers and political scientists who could surely help in this regard. I doubt if it is really necessary to accept, without question, routine negative responses from Attorneys General or Justice Departments, or from Cabinet Ministers.

The chief practical benefits of revitalizing customary law in this way would include the following:

a) the process could provide a forum for native people to consider seriously, without the pressures and polarization generated by some crisis, the very real ways in which the demands they currently place on wildlife resources are not the same as those of their forefathers.

b) it could serve to overcome the process identified by La Rusic (1979:137-147) in the implementation of the James Bay and Northern Quebec agreement, which has cost the

Cree hunters much of their autonomy and control in exchange for a stabilized regime of income and management. What we commonly understand as "traditional knowledge" would consist not simply of a set of observations about animal behaviour, but also rules for human conduct. There arises a greater possibility of modifying the "idiom of management" (La Rusic 1979:146) in favour of something that native harvesters could recognize as congruent with their own mode of thought.

c) an effective system of customary law and enforcement would both simplify the tasks of "official" wildlife managers and enforcement officers, and make those occupations more attractive to native people, since they would be implementing their own system, or something reasonably congruent with it, instead of an alien one. A management regime which hunters can understand, support, and even demand, is one which will require a minimum of enforcement and achieve a maximum of results.

d) while I am not suggesting that the use of customary law would remove the basis of conflict between traditional and scientific perceptions of wildlife issues, it could provide avenues of communication across barriers, not only the cultural ones, which many game managers already recognize, but also socio-economic and political ones.

e) it could provide the means for native people to regulate among themselves the geographical distribution of their hunting effort, chiefly by allocating group or individual rights to specific territories. This would not eliminate the rights of native people who do not adhere to the traditional mode, for example certain urban dwellers, but it could provide a meanns of regulating their access consistent with native traditions.

Finally, I hope this paper has shown the relevance of social scientific analysis to the problems of renewable resource management in the North. Once the biological information is in, management strategies turn chiefly to the regulation of human harvesting effort. In this respect, renewable resource management could benefit significantly by using social scientific analysis to a much greater extent than is now the case. I would urge, as I think must be evident from my analysis, that the use of social science in resource management not be limited to neoclassical economics.

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Some Thoughts Towards a Policy for the Rational Use of Renewable Resources in the Canadian North

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At the very beginning of my career I was warned by Eric Higgs, to whose memory I wish to dedicate this address, never to indulge in polemics. Eric's advice was, as usual, sound, and I have endeavoured with mixed success to follow it for some 15 years.

It seems to me, however, that the beginning of a symposium such as the present one excuses and even requires a polemic, namely a controversial or provocative argument. I am grateful, therefore, to the organizers of this symposium for providing me with an opportunity to indulge a fantasy that I have had to repress for too long!

Before turning to the substance of my speech, let me remind you that the etymology of the term "symposium" is the Greek verb meaning "let us drink together". I infer from this that a gathering such as the present one is intended to be a social, hospitable, and entertaining event, as well as an occasion for learning and the exchange of ideas. Let us hope that it will be so, and that in drinking together we shall learn together.

If much of what I have to say seems to be about people rather than resources, this is because what this symposium is principally about as far as I am concerned is the people of northern Canada. Even the most economically attractive and logical proposal to increase or diversify the use that we make of the renewable resources of the Canadian North will come to nothing if it is not tailored to the needs and aspirations of Canada's northern residents.

I hope that my words may help to provoke discussion and even argument in the following days, and that they may assist us in formulating plans for future *action*, since I am convinced that this symposium will be judged a failure unless it results in rapid and continuing action.

Indeed, I must insist that our discussions be predominantly practical. Jens Lyberth (1978:95) expressed eloquently a viewpoint that I share, and that I hope this symposium will adopt to guide its deliberations, when he stated:

> I have been involved with the development of the Canadian North for the last three years, and I keep hearing the same things repeated. When I read through Canadian history on the development of the North, I already knew what we were talking about this morning. So once more in 1978 we are talking about the same thing that was discussed back in 1969, and in 1970, 1971, and up to 1978. It is difficult for me to explain to my people what we are talking about here. We jump on into the future, trying to forget the reality of people who are trying to understand what the hell we are talking about here.

I have repeatedly heard the same frustration voiced by Crees, Inuit, and Naskapis in Québec, and I know from conversations with friends working in other parts of the Canadian North that it is widespread, if not universal. Indeed, I think that this dissatisfaction on the part of the Native peoples of Canada with the imbalance between talk and action on the parts of politicians, civil servants and scientists largely explains a phenomenon on which I shall touch latter — the refusal or reluctance of the Native peoples to participate in or to accept the results of "scientific" research projects in which they have not been personally involved.

The criticisms of the Native peoples are in fact restrained and reasonable. Exactly 60 years ago, Gordon Hewitt wrote that:

> The problems . . . confronting us involve a knowledge of the following questions: Of what does our wild life consist; what is its value; what are the factors that are responsible for its reduction and ultimate extermination; what steps are we taking to conserve it, and how can we improve on present methods with a view to conserving a valuable natural resource, the constituent parts of which cannot be replaced once they are lost?

I do not wish in any way to denigrate or downplay the immense contribution that has been made by individuals and institutions in Canada to answering the questions posed by Hewitt. Nevertheless, even the most optimistic could not claim that progress in matters concerning the knowledge, protection, and wise use of the renewable resources of Canada's North over the past 60 years has even remotely rivalled progress in such fields as aeronautics, medicine, and computer technology during the same period.

Finally, it is difficult to justify the enormous cost of a symposium such as this at a time when, at least in Canada, funds for basic research into renewable resources are critically short, unless the fruit of our discussions is rapid, sustained, and effective action.

Before turning to my chosen topics, I wish to place our endeavours in what I believe to be their proper perspective, thereby instilling, I hope, a little humility and a little optimism into our deliberations. What we are trying to do with the vast technological, intellectual, and economic resources at our disposal is no more than what the ancestors of today's Inuit and Indians succeeded in doing for perhaps 30,000 years, and what indeed many of them are still doing today!

The preceding observation is, for me at least, simultaneously a reason for humility and for optimism.

Reflections

The lack of a current policy. I have not attempted to conduct a survey of the numerous jurisdictions and agencies involved in order to ascertain in a systematic, argued, and fully defensible fashion whether there exists in Canada a policy or policies respecting renewable resources in the North.

I have not done so because it seems to me to be self-evident that no comprehensive policy or policies exist or that, if they do exist, they are not being enforced.

Given the immensity of the Canadian North and its ecological and economic importance, the absence of such a policy or policies must stand as a major indictment against Canadian governments at every level.

The reasons why no such policies exist are doubtless varied. They are, moreover, unimportant, save to the extent that an understanding of them might accelerate the development of appropriate policies and improve their quality. I have therefore selected three factors that I consider important.

The first is the fact that jurisdiction over renewable resources in Canada is split between federal, provincial, and territorial governments. Even within each level of government, jurisdiction over renewable resources is often divided between several departments or agencies. Such division and diversification of jurisdiction impede the formulation and implementation of policies for renewable resources, all the more so when there are potential conflicts between the use of renewable and non-renewable resources, since jurisdiction over the latter is usually unambiguously and powerfully defined.

The second reason that I have selected is not unrelated to the first. It is the lack of appropriate information to permit the formulation of adequate policies. It is true that there exist hundreds or even thousands of publications dealing with the fauna, flora, and waters of the Canadian North, but few of them are directly oriented towards questions surrounding their use. More important, no national synthesis of the renewable resources of the Canadian North and the manner in which they could be exploited exists. If those interested in the protection and wise use of the renewable resources of the Canadian North do not provide policy-makers with the information that they need to formulate policy, we may be certain that no policies will ever be formulated!

Thirdly with the possible exception of the governments of the Northwest Territories and of Yukon, the responsible governments have been oriented almost exclusively towards the southern parts of their jurisdictions, where voters are most numerous. When these governments have extended their activities into the North, it has been, with few exceptions, out of a desire to exploit the non-renewable resources for the profit of the south or of the international economic community.

The need for a policy. I take it to be self-evident that a policy or policies for the exploitation of renewable resources in the Canadian North must be developed.

I am not at all certain, however, that the development of such a policy should be our first priority. If I am correct in thinking that questions of jurisdiction will continue to be a preoccupation of the policy-makers — as seems abundantly clear, for example, in the current dispute over oil and gas between the Federal and Alberta governments — and that the information necessary to develop a comprehensive policy is incomplete and can be accumulated only slowly, then I believe that it would be better quite simply to embark upon a few imaginative and innovative projects to evaluate the feasibility of increasing and diversifying the use that we make of the renewable resources of Canada's North. The danger of this course is quite clearly the insecurity attendant upon any venture that is not supported by an explicit government policy. There are already conflicts between the exploitation of renewable and non-renewable resources, and their number is likely to increase. The extraction of oil, gas, and minerals is supported by government policy and by the money and influence of industry. At a very minimum, the wise use of our renewable resources requires the support of the responsible governments expressed through their policies, laws, and regulations.

I hope that this symposium will discuss and resolve the preceding issue.

The policy-makers. Despite the recent fervour in certain quarters for amending the Canadian Constitution, there have been no indications that, with respect to renewable resources, it might be updated to reflect the advances made over the past century in fields such as ecology, biology, ethology, and economics.

We must probably resign ourselves, therefore, to the fact that jurisdiction will continue to be divided between federal, provincial, and territorial governments, according in most cases to yesteryear's criteria of political convenience and apathy rather than on the basis of the best interests of the resources and those who depend on them.

Canada is passing through a period when politicians at every level are being forced to pay particular attention to the views of certain "special-interest" groups, including the Native peoples, conservationists, sport hunters, and anglers. These groups seem to exert an important influence on the formulation of policies, occasionally even to a point where their members risk being lulled into thinking that they are in fact the policy-makers.

It is important to remind ourselves from time to time that policies are made by politicians and can under our laws be made only by politicians. In other words, policies respecting the renewable resources of Canada's North will continue to be made as a general rule by persons from the south who are largely ignorant of if not indifferent to the scientific bases of renewable resource exploitation and who, experience would suggest, are often more favourably disposed towards spectacular, revenue-generating projects involving the exploitation of oil, gas, and minerals.

The preceding observations justify and even demand a full and vocal participation in the formulation of policies on the part of scientists, Native persons, and other informed and interested individuals and groups.

Policies are easy, cheap, and politically rewarding to formulate, but they remain ineffectual unless they are adequately enforced. The long-term cost of applying a policy is vastly greater than that of formulating it, whereas the principal political "pay-off" can be gained from publicity generated around its formulation and adoption.

It is not totally unjustified to suggest, therefore, that politicians may occasionally yield to the temptation to formulate policies that they have no genuine intention of applying. If this symposium decides, as I hope it might, to create a body to press for the development of appropriate policies within Canada, I hope that it will recognize the need for a mechanism to verify their proper application and that it will ensure that the adoption of any policy is accompanied by the voting of the necessary budgetary credits.

The attitude of the Native peoples. I am not aware that any systematic attempt has been made to evaluate the attitude of the Native peoples of northern Canada towards scientists and the other persons who would probably be involved in some capacity in any attempt to exploit rationally the renewable resources of northern Canada. Indeed, given that most of the Native peoples of northern Canada do not have any established tradition of expressing their views publicly in writing, it is doubtful that any technique other than interviews in Native communities across Canada would yield an accurate portrait of the prevailing attitudes.

As an employee of the Naskapi Indians of Schefferville, Québec, I sit as an advisor on what is known as the Hunting, Fishing, and Trapping Coordinating Committee, where the James Bay Crees and the Inuit of Québec are also represented, along with the governments of Canada and Québec. The purpose of the Coordinating Committee is to review, manage, and in certain cases, supervise and regulate the Hunting, Fishing and Trapping Regime created by section 24 of the James Bay and Northern Québec Agreement.

The Coordinating Committee has now been meeting for some six years, during which time three major attitudes on the part of the Native representatives have impressed me: a dissatisfaction with their involvement in research and the application of its results; a mistrust of providing information to scientists, lest the information provided should be used to formulate or implement policies that go against what the Native peoples believe to be their best interests or those of the resources involved; and a lack of confidence in some of the techniques used by biologists.

The First Québec-Labrador Caribou Conference was held in Schefferville in 1977 to provide a forum where the Native peoples of Québec and Labrador, scientists, and government representatives could talk openly about their respective problems, knowledge, and concerns for the caribou of the Québec-Labrador Peninsula.

The following quotations from the transcript of the conference (Centre for Northern Studies and Research 1978) illustrate the preceding contentions:

> Q. (I. Juniper) Is there a selection in hunting caribou? Or do the Native hunters just hunt at random?
>
> A. (J. Peters) We are not going to answer because we do not know what Québec will do with the information we give.
>
> Q. (Northern Quebec Inuit Association) If we give information to these people, how do we know that this information will not be used against us to make more laws and regulations?
>
> Q. (J. Peters) . . . because of your studies, the Inuit of Labrador have now very little chance or power to hunt caribou, because the biologists are in the field, frightening the herd with aircraft and getting information for their own benefit, and not for the benefit of the people.
>
> Q. (A. Kojak) There are two things on my mind that bother me: one is that the biologists can chase and survey the caribou with aircraft, if they want. The second is that I am not even allowed to chase the caribou on skidoo for purposes of eating . . .
>
> Q. (W. Anderson) As far as I am concerned, I think the law is crazy. I went 300 miles to hunt caribou. When I got there, I did chase the caribou with my skidoo. If I could not do this, I would make that long trip for nothing. I would break any of these crazy laws to get the caribou I need for my family.
>
> Q. (J. Peters) The biologists of Newfoundland care more for animals than for people, and they make regulations accordingly.
>
> (Tomassie Kudluk). My name is Tomassie Kudluk . . . I live above Camp Bay area, and the caribou of this area are mine. They are my caribou. I am Inuk and I eat all

of a caribou. I do not believe in biologists trying to interfere with these animals, which I know and which are part of my culture. I know the way they feed themselves, and I know that, when the weather makes the snow too hard for them to be able to reach their food, they leave and travel to other places where they can feed themselves. The Crees, Inuit, and Naskapi, and all the Natives have been in this country long before the Whites, and should be respected. I am Inuk and I eat the way I want to eat. I want the biologists and the people from the Government to understand that I have learned all my life the caribou's behaviour, and that I do not want to eat bread when I can eat caribou.

Q. (T. Kudluk) I do not believe that you can find out anything about the caribou's behaviour with jawbones.

A. (E. Mercer) We do get good information with jawbones . . .

Q. (T. Kudluk) I think I can provide more information out of my own experience.

(Stewart Luttich) You people seem to forget that we are only biologists and not politicains.

(Johnny Peters) I do not believe you are not a politician since you are helping the government by providing information.

If I seem to have dwelt at length on the preceding quotations, it is because I find them as disturbing as they are eloquent. It is not for me to defend their accuracy or otherwise to justify them. What is important is that they seem to be representative of an important, if not prevailing, body of opinion among the very people upon whom the implementation of any policy to improve the exploitation of the renewable resources of Northern Canada must depend.

The involvement of the Native peoples in research. Most of those who work in the Canadian North are coming to realize that the time has passed when good relations with the local Native community could be assured by hiring a "token" Inuk or Indian to act as a "guide", "informant", or camp-custodian.

There is a growing recognition in theory, although not as often in practice, that Native persons must be genuinely involved in the planning and conducting of research in the field, and also in the analysis, publication, and application of the results of this research.

Scientists seem reluctant, however, to accept one consequence of their admitting the Native peoples as partners to their research: namely, that occasionally they will be required to modify or even abandon a given research project because it does not command the support of the Native peoples.

If the Native peoples are to become properly involved in northern research, changes will also have to be made within funding agencies: travel to and from northern communities for consultation prior to research, during analysis of the results, and while preparing the results for publication can easily cost thousands of dollars; the research priorities of the Native peoples do not always coincide with those of funding agencies; and the personnel involved on behalf of the Natives will not always have the formal education that is required by many funding agencies.

There is a growing number of examples to show that Native persons lacking formal education can contribute significantly to major research projects: land-use research in Labrador, Québec, the Northwest Territories, and the Yukon; studies of harvesting by Crees and Inuit in Québec; and studies of eider ducks and beluga whales in Québec and the Northwest Territories.

The use of "traditional" knowledge. The studies referred to in the preceding paragraph illustrate not only the ability of the Native peoples to participate in major research projects, but also the value of the information that individual Indians and Inuit have acquired as hunters.

There has certainly been a tendency on the part of scientists to reject or underestimate the value of so-called "traditional" knowledge, and this must be rectified.

But there has also been an unfortunate tendency on the part of some Native persons to insist on the accuracy of their data merely because they are Indians or Inuit, and this is no more acceptable than a blind insistence on the correctness of "scientific" data or techniques. Scientists and Native persons alike must accept that their information and techniques be evaluated wherever it is possible to do so.

The "politicization" of the Native peoples. While I am treading on this delicate ground, I feel obliged to comment briefly and politely on a trend that I see emerging and that I refer to as the "politicization" of the Native peoples.

Since the late 1960's, the Native peoples of Northern Canada have been thrust into the forum of provincial, national and even international politics. Their degree of success is a tribute to their resilience and abilities.

One unfortunate consequence is the occasional tendency on the part of some of the leaders of the Native peoples to practice a type of political "linkage" between spheres of activity that would otherwise be considered independent.

I hope that it will be possible to maintain the preservation and wise use of the renewable resources of the Canadian North at a level superior to that of political bickering and trading.

The myth of distance. The potential of Canada's renewable resources in our national economy and in our international economic transactions is sometimes discounted because of the costs of transporting the products from supposedly remote northern areas to national and international markets.

I cannot but believe that this is a myth in an economy that transports oil from the Middle East to the most northerly Canadian village and in which it is considered "economical" to transport to the North trophy hunters from the south who are apparently willing to pay up to $2,000 per week for the dubious honour of killing a single caribou and taking a few dozen fish.

One of the principal exports of New Zealand is venison, which comes from red deer harvested in remote areas by helicopter, and which is sold without apparent difficulty in West Germany and other European countries. It is difficult to imagine why the products of harvesting in Northern Canada could not compete on the domestic or international markets with red deer from New Zealand.

I am not in general an adherent to "conspiracy theories". Nonetheless, I cannot help but be reminded of the view that the reindeer-husbandry industry in Alaska was killed in the early part of this century by pressure exerted by Chicago meat-packers on railroads that had agreed to serve reindeer venison in their dining cars, but which depended heavily on contracts for freighting cattle to the abattoirs of Chicago!

I am aware of no such pressure in recent times, but it is not in my opinion unfair to say that business and government have given suspiciously little encouragement or incentive to studying and developing the renewable resources of Canada's North.

Cost. I am not qualified to estimate how much it might cost to establish northern enterprises to utilize renewable resources, and I do not intend to do so.

When I worked with John Teal's musk-ox domestication project in Alaska, however, I was frequently asked how much it had cost to capture the musk-oxen and to establish and operate the farms. The truth was that I did not really know, but I would answer that it had probably cost around one million dollars. The invariable reaction of the questioner was one of amazement tinged with horror.

I recount this anecdote because I believe that it reveals a fundamental and unrecognized misconception in our society that enterprises based on renewable resources should, like the farms of two or three centuries ago, cost virtually nothing, whereas it is perfectly legitimate for industrial developments in the North to cost billions of dollars.

The cost of any project must be evaluated in the light of the profits that it will eventually generate and the direct and indirect contribution that it will make to our society.

I am convinced that the research and other costs associated with the wise development of the renewable resources of northern Canada will be high, if we think in the terms of yesteryear and of sheer profit and loss, but very low if our criteria include social and environmental benefits.

In their dealings with government, I urge scientists and Native persons to face realistically the question of costs and not to forget that many of our foremost industries enjoy "hidden" subsidies, while some companies, such as Tricofil in Québec, have enjoyed outright grants from government, and others, such as Chrysler Corporation, have had loans forgiven or guaranteed.

Trophy hunting and fishing. I find trophy hunting and fishing barbaric. However, I do not find them significantly more barbaric than my native country's national sport of hurling, for example, or Canada's national sport of hockey, and there is as little chance that they will disappear as that hockey will disappear.

Indeed, given their economic importance, it seems certain that trophy hunting and fishing will continue to play a role in the exploitation of the renewable resources of Northern Canada. One authority has calculated that a fish taken by an angler generates 32 times more revenue than if the same fish were taken by a commercial fisherman!

I shall make only two comments in connection with trophy hunting and fishing.

First, I am convinced that one necessary and important step is to make licence fees reflect the value of the resource. The minimum fee for a caribou licence in Canada today should be several hundreds of dollars, assuming that the meat harvested is worth no less than $3 per pound. The revenues generated could be used to sponsor research into the conservation and utilization of renewable resources in the North. Moreover, a high licence fee would discourage the wastage of meat by sport hunters, a subject of frequent and justified complaint among Native subsistence hunters.

I have unsuccessfully advanced the preceding idea to representatives of governments. Their first reaction is that such a policy would in some sense be punitive or discriminatory against sport hunters, because sport hunters already spend large amounts of money to travel to the North for purposes of hunting or fishing and are thereby entitled to some sort of "discount" off the value of the "product" that they wish to "purchase". I find this lack of logic surprising: a person who, of his own free will, travels to Resolute to buy a pound of beef would not expect the store to charge him half-price; nor does the Inuk or Indian who travels to the south find himself uniquely greeted with discounted prices on items produced in the south!

It is clear, moreover, that sport hunters and fishers constitute a wealthy and privileged class. They are able to spend hundreds or thousands of dollars for a few days' hunting or fishing. There is no reason to believe that they could not pay the full value of the meat that they take.

I am disturbed by the political weight of trophy hunters and fishers in North America and by the fact that government departments responsible for the renewable resources of the Canadian North are staffed by disproportionate numbers of advocates and practitioners of trophy hunting and fishing. This imbalance might be understandable if trophy hunting and fishing represented the principal means of using the renewable resources of the North, but this is not the case, and I do not believe that it ever will be. Precise figures are not available, but it seems to me improbable that trophy hunters and anglers will ever be capable or desirous of using more than a few per cent of the harvestable resources of the Canadian North. Their political weight should be in proportion to this figure.

The "rights" of trophy hunters and anglers are not, of course, couched in economic terms, but in terms such as "wildlife heritage" and "patrimony", replete with references to man's dubious evolution as a hunter. It is to be hoped that such misleading rhetoric will not continue to be the basis of our policy for protecting and utilizing the renewable resources of our northern regions.

Let it be said in closing that, to the extent that trophy hunting and fishing continue to be an element in the use of our renewable resources, all efforts should be made to place control and the resulting economic benefits in the hands of northern residents, especially Native persons.

The attitude of fish and game columnists. In my view no policy respecting the improved protection and use of the renewable resources of the Canadian North can succeed unless it is implemented largely by and with the full consent and collaboration of the Native peoples and, it is to be hoped, of the general public.

Most major Canadian newspapers have a "fish and game" or "out-doors" columnist. Regrettably, many of these columnists seem to be committed to a policy of denigrating the

willingness or ability of Canada's Native peoples to act responsibly towards wildlife. If the general public ever comes to share this view, it will become all but impossible for politicians to advocate a policy for renewable resources that depends heavily for its success on Native peoples active co-operation.

I have neither the time nor the knowledge to document my claim that fish and game columnists are systematically trying to discredit the Native peoples. Suffice it to note, however, that the situation is sufficiently serious that the Québec Human Rights Commission has seen fit to publish a lengthy report on the subject (Vincent 1979).

The need for research. Whenever a consultant or an academic stands up in public and advocates the need for research, the wise listener has good reason to be cautious. The most charitable interpretation that can be given to such claims is that the consultant is seeking work for himself, while the academic is seeking work for his graduate student. I am a consultant, and I make pretensions to be an academic, so you must be doubly cautious!

Nevertheless, I think that the need for research into the renewable resources of northern Canada is self-evident. First of all, as I noted above, we quite simply have little idea about such basic questions as the numbers, distribution, and potential uses of the resources at our disposal, a situation that would have been rectified (if it had ever been allowed to develop) in any of the more traditional spheres of our economy. Equally important, however, is my conviction that the starting point for any policy that might be formulated must be a sound understanding of the needs, aspirations, and subsistence requirements of the human populations involved, and of the limitations imposed upon what we can do by the biological and behavioural attributes of the resources that we wish to exploit.

The need for information about the human populations is, I believe, self-evident, and I shall pursue it no further. My emphasis on the importance of our understanding of the biology and behaviour of the resources, however, perhaps merit a little elaboration.

Our agricultural economy depends on a surprisingly few species of plants and animals, which we have over millennia moulded according to our tastes and desires, and which we continue to manipulate in the same way. We have come, therefore, to see plants and animals as fitting objects for the imposition of characteristics that we consider desirable, and we tend to recognize no limitations other than those imposed by our ingenuity and technology.

The fact that millennia of effort have subjugated to "western" agricultural technology only an infinitesimal number of species of plants and animals and a tiny fraction of the globe should inspire caution and humility in us.

I have argued elsewhere that the principal factor determining prehistoric man's exploitation of musk-ox and other species was the biological and behavioural characteristics of the animals themselves, coupled with the need to integrate their exploitation into a viable round of subsistence activities (Wilkinson 1978). I do not wish to downplay man's achievements since the Paleolithic, but I do not believe that he has yet escaped from the preceding constraints.

The starting point for any successful policy concerning renewable resources must be the acquisition of the knowledge necessary to identify the boundaries on exploitation imposed by the resources themselves. Not that these boundaries will be static, or that further

research to extend them should not be encouraged. If prehistory holds a single lesson for us, it is that man can use his intelligence to amplify "the gift of dominion", despite his all-too-frequent tendency to abuse it.

The other area in which I am convinced that we can use our ingenuity is in the use to which our natural resources are put. When I worked on commercial hunting of red deer in New Zealand, I was struck by the fact that one-half of the revenue per carcass came from non-meat products: "velvet" from the antlers, and testicles and tail-glands for aphrodisiacs. More recently, I have had a little experience with the use of lichens as natural dyes for qiviut, the underwool of musk-ox, and I have read about the use of pressed, heat-treated peat to produce construction materials and insulation, or, more simply, peat as a source of fuel in the North. I cannot but wonder whether there are no pharmaceutical applications for renewable resources from the North.

Whilst on the topic of research in the North, I feel obliged to comment on what I believe to be the myth surrounding the difficulties of acquiring basic data about renewable resources in remote northern areas.

I am an admirer of the exploration of inner and outer space. Only a few weeks before the recent voyage of the space-shuttle "Columbia", I was involved with several colleagues in debates concerning our inability to accurately count caribou in a part of northern Québec and musk-ox on Banks Island, Northwest Territories. The contrast could not have been greater when I read in the newspaper that American scientists possess a telescope that can count the tiles on the belly of the "Columbia" or identify a golfball from a distance of 120 miles! I do not know whether the disparity reflects a lack of ability on the part of the individual scientists involved, or the priority (and funding) given to space and renewable resources by our governments, but it does seem to me that, as managers and custodians of our renewable resources, the immediate importance of which is not less than that of space, we are failing in our responsibilities and ought to resolve to do better.

Land claims and the exploitation of renewable resources. The view seems to be emerging that policies and programs for using the renewable resources of the North and, more particularly, for involving the Native peoples should be closely linked to the negotiation and implementation of land-claims settlements. I do not fully share this view. I do not believe that the claim of the Native peoples to a special role in the use of northern renewable resources should be held to derive exclusively from an aboriginal or similar right. If their special status were seen as deriving from such a right, it would be a right that could be abolished by competent legislation; moreover, those Native groups that have already ceded or had extinguished their Native rights would be deemed to have lost their claim to a favoured participation in programs of renewable resource exploitation.

There is an additional, practical argument that has perhaps greater weight. Experience in the implementation of the James Bay and Northern Québec Agreement and of the North-eastern Québec Agreement suggests that land claims are not an especially good mechanism for promoting the involvmeent of the Native peoples in the exploitation of renewable resources. The principal problem is that there is little or no incentive for the governmental signatories to these agreements to ensure the full and rapid implementation of the articles according to the Native signatories a special role with respect to renewable resources. The "concessions" in this field gained by the Natives were usually won grudgingly, and the government negotiators tend, perhaps subconsciously, to see them as something that was "lost" by the non-Native population. Moreover, politicians and civil servants who have

been traditionally oriented towards sport hunters and anglers often have little personal inclination towards fulfilling such commitments. In addition, experience in Québec has shown that it can take many years to inform civil servants of the existence of agreements and of their contents. Finally, there is often no short-term financial or political gain to the governments in fulfilling their obligations more than cursorily. The gains to the Native parties, on the other hand, are immediate and important. One finds in consequence a situation in which the Natives continue to fight the governments, and in which little is achieved.

In my opinion, the right of the Native peoples to a special role in the development of the renewable resources of the Canadian North derives from the fact that, with few exceptions, they are the only truly permanent residents of northern Canada and that they are the only collectivity that possesses the knowledge, expertise, and inclination required for the proper exploitation of the renewable resources of the Canadian North.

The foregoing is not to say that settlements of so-called "land claims" should not include provisions relating to renewable resources. I believe that they should, and that they provide one basis for assuring a certain exlusivity for the Native peoples in matters concerning the exploitation of renewable resources and for enacting into law a special status for the Native peoples.

The attitude of governments has been curious in this respect. While in the south they demand apprenticeships, university degrees, union membership, and licences before permitting individuals to practice a trade or profession, there are few or no comparable requirements for persons wishing to involve themselves in the exploitation of renewable resources in the North.

It might be appropriate for this symposium to reflect upon this anomaly and to attempt to formulate a series of realistic criteria that would for once take account of the knowledge and experience of so many Native persons.

I do not wish to be interpreted as suggesting that non-Natives should be precluded from participating in the development of the renewable resources of the Canadian North. It seems clear to me that they will have to be involved, at least temporarily, in some aspects, such as planning, management, accounting, and marketing. There are indeed many non-Natives with a deep understanding of and respect for the North, and I hope that any policy that might be developed would encourage their collaboration and participation.

I am convinced, however, that efforts must be made to concentrate in the North any economic or social benefits derived from renewable resources. In order to achieve this, criteria of residence or other mechanisms must be established to minimize the danger that the phenomena of gold and oil "rushes" from the south be repeated.

A question of scale. I do not intend to deal at length with the question of the orientation of programs encouraging the wise use of the renewable resources of the North. I consider it axiomatic, however, that the first objective of such programs should be to satisfy local demand in the North, whether that demand be for cash, food, or something else.

An economic venture that might create three or four seasonal jobs is usually rejected in the south. Most northern communities are small, however, and the rates of unemployment, especially among the Natives, are extremely high, commonly 75 per cent or more. In such

situations, enterprises based on renewable resources that create only a few full-time or part-time jobs can have a major impact in reducing unemployment and should therefore be encouraged.

In this context, it is to be noted that many government programs to stimulate job-training or the creation of businesses among Native persons are also conceived of in "southern", large-scale terms and hence preclude small ventures or discourage Native participation by virtue of their administrative requirements.

Any proposal for the rational development of the renewable resources of Northern Canada should include a re-evaluation of the applicability of existing programs of training and job-creation in the contemporary social and economic context of the North.

Laws and Regulations

The principal laws and regulations at the present time are those governing sport-hunting and angling. At least in provinces that have northern and southern areas, the tendency has been to apply, with few or not changes, laws and regulations devised in the south. In many cases, the northern parts of these provinces, which in some cases cover several hundreds of thousands of square kilometres, have been treated as a single, large management unit. The results of this approach have been to have fishing seasons open during spawning seasons and to have bag or possession limits that are higher than can be supported by the low rates of growth and reproduction of northern populations of animals.

The reasons why such a situation should ever have arisen will probably never be known. The principal explanation is undoubtedly ignorance about the renewable resources of the North, coupled with political considerations, such as ensuring that hunting and fishing seasons coincide with traditional vacation times in the south. It is obvious, however, that laws and regulations governing renewable resources in the North must derive from a knowledge of the North and must be tailored primarily to the needs of northern residents.

My second observation is to the effect that so-called "hunting and fishing" laws and regulations will not be sufficient to control any comprehensive program for exploiting the renewable resources of the Canadian North. Sport hunting and angling will, as I have acknowedged above, probably continue to be one element in the use of renewable resources in the North, and they will, of course, have to be regulated.

As the exploitation of these renewable resources increases and diversifies, however, particular attention will have to be paid to establishing the regulatory framework that will undoubtedly become necessary. One many eventually envisage a body of regulations comparable to those that currently govern agricultural activities in the south.

I hope that this symposium might address itself to establishing guidelines for the makers of these laws and regulations.

Having recognized the need for laws and regulations, I wish to make a plea that they not be allowed to stifle the development of northern enterprises based on renewable resources. The laws and regulations must be allowed to grow from the knowledge and experience that will be accumulated; they must not be imposed in advance by southern persons ignorant of the North and its resources. Even today, regulations governing the slaughter of meat for sale and laws that totally forbid the sale of game meat hinder the development of even

the small-scale marketing of game in parts of the North. The regulations in question were derived for the south and its urban societies, climate, parasites, and other hazards to health. They are not appropriate for the North and are unlikely to become so in the foreseeable future.

Recommendations

I will restrict myself, for the moment, to making three recommendations:

First, that steps be taken immediately to prepare a synthesis of current knowledge concerning the renewable resources of the Canadian North and the ways in which they can be used widely, such mechanism to provide for the constant updating of the corpus of knowledge and ideas that will be compiled;

Second, that the Native peoples be provided with whatever funds and other assistance they require to conduct a nation-wide survey of relevant matters that they deem to be of interest, such as their attitudes towards the increased and diversified use of the renewable resources of the North, the role that they would wish to play, and their current harvesting activities;

Third, that at least one pilot project be started in the North before the end of 1981 to demonstrate the intention of this group to translate words into actions and that this symposium reconvene only upon the termination of that project.

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The Reindeer Industry in the Western Canadian Arctic: Problems and Potential.

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Historical Background

Reindeer herding in the Western Arctic of Canada owes its beginning to a Royal Commission that was established in 1919 to investigate the possibilities for establishing a reindeer and musk industry. The Royal Commission reported in 1921 that there appeared to be good prospects for the establishment of a reindeer industry that would bring a secure supply of meat and skins to local Eskimo people, and at the same time provide a potential food source for southern workers seeking to extract minerals from the North. The Royal Commission cautioned, however, that it was necessary to have a scientific assessment of the carrying potential of the proposed range before animals be brought in.

In the late 1920's A.E. Porsild did field evaluations of the flora in the proposed reindeer grazing area and concluded that there appeared to be adequate vegetation to support a large herd, possible in the order of three hundred thousand animals. On the strength of Porsild's report and the recommendation of the Royal Commission, the Government of Canada arranged to purchase approximately thirty-four hundred reindeer from an Alaskan herd at Kotzebue, in late 1929. Herders from Lapland were engaged to assist local Alaskan Eskimos in moving the new herd from Alaska to the Mackenzie Delta. During the five years of this great trek, the number of animals decreased from the original thirty-four hundred to the approximately twenty-four hundred that were delivered in the spring of 1935. However, the fawn crop of that year, of about eight hundred animals, made a welcome addition to the starting size of the Mackenzie Delta herd.

A number of articles have already described the history of the Mackenzie Delta herd from its beginning in 1935 into the early 1970's (Scotter 1972; Treude 1979). Therefore, it will not be necessary to go into great detail here except to say that the intention of the Government of Canada was to have a number of reindeer herds operated by local Eskimo people in order to generate employment and at the same time provide a secure source of food for the area. Security of food supply was a great concern at this time because of experience with the crews of whaling boats wintering in the area and placing heavy strain on local caribou resources. It was hoped that the reindeer industry would supplement available caribou.

The Government's approach was to maintain a central herd that would be controlled directly by the Federal Government. This herd consisted of thirty-five hundred to four thousand animals, with approximately three to five hundred fawns available each year to be contributed to independent, locally-controlled herds.

Early Management Problems

The first locally owned herd was established in 1930 and during the following 16 years a further five herds, each of a little less than a thousand animals, were established. These herds persisted for some years, but without a great deal of success. In some cases the original animals loaned to the owner for start-up were returned to the Federal Government and the herds appeared to be doing well. In the long term none of the privately-owned herds survived beyond 1964, at which time all of the reindeer had been returned to government ownership and control.

From 1960 to 1968 the government herd was placed in the hands of contract managers who were to attempt to increase the size of the herd, and at the same time to raise the maximum revenue possible from meat sales. During that period the number of animals in the herd fell from approximately seven thousand at the outset to two thousand seven hundred in 1967. During this time, the costs of operation exceeded revenue by a ratio of three to one.

Needless to say, the Federal Government was not pleased with the results of the experiment with reindeer up to that time. It was decided that the Canadian Wildlife Services would be asked to take charge of the project to provide a breathing space during which the future of reindeer herding could be assessed.

During the next five years, a number of alternatives were considered by the Federal Government. These options were:

- Let the reindeer walk off to join the caribou herds migrating past the Husky Lakes to the east of the preserve;
- Hold an open season on the hunting of reindeer, including inviting trophy hunters;
- Slaughter all animals for local meat consumption over a four-year period;
- Keep the herd at its present size and condition in case a demand for meat would arise in the future;
- Attempt to expand the size of the herd to approximately thirty thousand animals so that the reindeer industry could become a profit-making venture;
- To offer the herd for sale to some of the senior herders.

New Beginnings

Professor John Stager, of the University of British Columbia, was retained by the Federal Government to study the various options and to make recommendation for the most desirable course of action with regard to the future of the reindeer industry in the District of Mackenzie. Professor Stager studied the people involved, carried out projections of herd size and cash flow, and concluded that it was possible for the reindeer herd to be operated on an economically viable basis, and independent of government assistance. On the basis of Professor Stager's study, the entire reindeer holding of the Federal Government was sold to a new company called Canadian Reindeer Ltd., which was owned by the former chief herder Silas Kanagegana. The herd consisted of fifty-two hundred animals at the time of the purchase in 1974.

Although Mr. Kanagegana received some assistance from the Territorial Government, Department of Economic Development, in regard to business advice, he operated the herd essentially without any financial assistance from government until his deteriorating health in 1977 caused him to decide to sell the business so that he could retire and devote more time to his calling as a lay minister. The herd was then sold to the present owner.

At the beginning of the private enterprise period, the reindeer business was held back by an absence of cash flow. This was the result of a very small local market for meat (approximately 300-400 carcasses per year), and the inability, due to government meat inspection regulations, to sell meat in the rest of Canada. For these two related reasons the herd could not become viable as a business. In view of this critical situation, the Federal Department of Agriculture agreed to work with Canadian Reindeer to develop a portable slaughter facility that would meet the standards for slaughter-house establishments in other parts of the country. Over an eighteen-month period of consultation and trial and error, a slaughter house was constructed in a tent approximately forty feet long, ten feet wide and eleven feet high. This facility was approved on a temporary basis by Agriculture Canada for use only when the temperature was below zero degrees fahrenheit and when set up over a source of potable water. This system worked quite well for three years and slaughters were carried out on a frozen lake, with meat transferred to market by truck or plane.

With the new facility, it was possible to sell meat that was surplus to northern requirements to markets in southern Canada. Initially, Woodward's Stores of Vancouver was the sole marketing agent in the south. Meat prices in the Mackenzie Delta area were kept to seventy-five cents a pound in the first two years, and thereafter allowed to rise to eighty-five cents a pound, which is still the prevailing price.

Growth and Development of the Reindeer Industry

As the herd size continued to grow and approach ten thousand animals in 1979, it became obvious that the tent slaughter facility would not be adequate to process the required number of animals in coming years. Dr. Gordon Godkin the veterinarian in charge of the establishment for Agriculture Canada continued to work with the company to improve the slaughter house. A series of trailers on sleighs was developed for bunkhouse, cook house, and dining room, washhouse and a large enclosed building, also on sleighs was constructed as a new slaughter facility. There was no government financial assistance given, or requested, for these improvements. During this time the Dempster Highway was opened linking the Mackenzie District to Southern Canada via the Yukon Territory. This permitted trailer loads of meat to be taken south to market much more economically than had previously been possible using air freight.

Also during this time, a new cash crop emerged to further improve the financial viability of the reindeer industry, namely the sale of deer antlers to the oriental market as a component in medicines. The development of this market allowed the company to carry out a summer roundup using helicopters for herding and thirty to forty workers at the corral to do ear tagging of each year's crop of animals and to carry out castrations so that steers would be available for subsequent slaughtering. The close examination of the animals in the corral and shoot areas permitted the veterinarian, Dr. Godkin, to check the general health of the herd and to carry out blood sampling when necessary. At this time also the close inspection allowed animals to be selected for slaughter in the subsequent winter period and to be marked with a fluorescent orange ear-tag that could be easily identified at the winter roundup.

The improvement in the company's cash-flow position as a result of the new southern market for meat and the Oriental market for antlers permitted other changes in the operation of the herd. It became possible to afford better equipment for the herders and to purchase a fixed-wing aircraft to improve surveillance for stray animals and a bulldozer

for keeping the airstrip and summer roundup area in usable condition. Given these improvements in herding techniques and equipment, the herd increased in size to thirteen thousand animals as counted through the corral in June of 1980.

Potential Problems and Concerns

The relatively rapid expansion of the herd from fifty-two hundred animals in 1974 to thirteen thousand in 1980 brings with it certain concerns. The major potential problem is that the range may be over-grazed in certain areas, particularly areas of reindeer moss, which is essential for wintering the animals. Over-grazing is a problem with any extensive ranching operation, but it is even more of a problem on permafrost where regeneration after overuse can take thirty to forty years. In view of this potential problem, and with assistance from the Department of Indian Affairs and Northern Development, Professor Peter Murtha of the Faculty of Forestry, University of British Columbia, was retained last summer to carry out a monitoring program over the reindeer preserve using remote sensing techniques. Specifically, Professor Murtha marked out one acre plots on the ground with a clearly visable white X on each corner. He, and his assistant, Richard Sims, then carried out a detailed survey on the ground to determine every plant that was growing within those squares. The squares were then photographed from the satellite, using infra-red film. The resulting photographs were then compared with the actual plant life found on the ground. In this way, it was possible for Professor Murtha to extend his conclusions across other statellite photographs to assess the suitability of the land for wintering reindeer and to identify areas where over-grazing, as indicated by an absence of reindeer moss, had occurred. It is now hoped to carry this study forward for a second year and to assess the reduction in reindeer moss in areas where the animals were wintered this year so as to come to an estimate of the carrying capacity of the range.

Until the assessment of the carrying capacity of the range has been completed, it is intended that large slaughters (in the order of two to three thousand animals) will be carried on each year to hold the total number of reindeer below fifteen thousand animals.

Future Developments

As an alternative to carrying out large slaughters each year, it might be considered appropriate to return to one of the original objectives of the herd, that being the establishment of new locally owned and controlled herds in the North. It now seems feasible, not only from the economic point of view, but also from the point of view of animal husbandry, to transplant a group, perhaps two to three thousand reindeer, to a new site and to create a reindeer industry where none now exists. Such a course of action would necessarily involve extensive consultation with local people and detailed assessment of the likelihood for success. It does seem, though, that there are areas where such a transplant would be both welcome and feasible.

Given the new size and relative economic stability of the reindeer industry in the Western Arctic of Canada, there are now a number of other potential development options that appear attractive. There are a growing number of tourists in our area that each year seek experiences that are unique to the locality. It has been suggeted that perhaps a group of reindeer in a close-herding situation near Inuvik or Tuktoyaktuk would be a desirable tourist attraction. Such a project might also provide a valuable opportunity for researchers to observe animals at close range, and also has potential for the establishment of a dairying industry that could provide hormone-free milk and other dairy products for a local and

southern consumer market. Further, when other protein resources in the area are considered as well as reindeer, it may be feasible to establish a meat processing plant in one of the larger communities to maximize the local advantage of renewable resource harvesting.

Along with these exciting possibilities there are also some recent trends in our area that threaten the prosperity of the industry. As yet the dramatic increase in oil and gas exploration on the Preserve during the last five years has not had negative effects on reindeer. In fact there have been some benefits through improved access to the summer corral area. If, however, these wells enter a production phase, there will be markedly increased activity and potential for atmospheric and shore-line pollution, with obvious attendant deterioration of the reindeer habitat and increased herding costs.

Canadian Reindeer believes that these possible difficulties can be minimized and controlled given a continuation of the co-operative attitude shown by the oil companies in the past.

Another source of concern is the possibility that large tracts of the Reindeer Preserve may be set aside for ownership by native organizations as part of land claims settlements. This change from Crown Land status could bring unknown changes and conditions for use that could make reindeer herding an uneconomical use of the land.

Conclusion

It may be said that the reindeer industry in the Western Arctic of Canada has taken 45 years to get to a position where its original objectives can be achieved. There is now ample meat harvested to supply a cheap protein source for the area. There is now a surplus of animals of sufficient magnitude to allow new herds, of an economically viable size, to be established under local ownership.

Further, the Federal Government continued to support the reindeer project through many unsuccessful years and deserves much credit for the present state of the industry. Similarly, Agriculture Canada has contributed consistently and directly to the marketability of reindeer products, without which economic viability would have been impossible.

At the present time, the reindeer herd is growing rapidly and steps are being taken to determine the carrying capacity of the range. Potential exists for establishing new herds and for starting some small businesses in meat processing, tourism, and dairying, that are dependent on the main reindeer herd.

On the other hand, both major petroleum development and the settlement of land claims create an element of uncertainty for the reindeer industry in the Western Arctic of Canada.

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Following Mr. Nasogaluak's talk, there were a number of questions directed to him and to Dr. Billingsley. An edited transcript of the recorded discussion follows.

Q. Could you comment on the status of the antler market?

A. We don't want to place reliance on it. It's an ephemeral market. We don't know how stable it is, but it provided windfall cash allowing capital outlays (purchase of a bulldozer, for example). The operation is economically viable, however, on the basis of meat sales alone. We are researching the antler market, with the federal department of Industry, Trade and Commerce, and should have a better idea of future status of that market in the Far East over the next few months.

Q. What is the status of wolves, are they a problem on the range? How many wolves do you have to kill each year?

A. Reindeer attract all sorts of animals — ptarmigan, foxes, grizzly bears, etc. We are out with the herd, so wolves are no longer a problem. I haven't seen a wolf track near the herd over the past three months, so that is quite a change from the past situation.

Q. The herd has increased faster and markedly in the past few years; do you attribute that to the decrease in wolves near the herd?

A. That could be part of the reason; wolves were a major problem in the earlier years, as they couldn't be caught by herders on skis. Herding techniques are improved as we can look after the reindeer much better with skidoos. That might have helped.

Q. It has been reported elsewhere that ravens are a cause of calf loss. What is your experience with predators?

A. There is some calf loss. Foxes may kill a fawn, but the herd is increasing so we don't see it as a problem. Ravens aren't a problem, nor are foxes; they have to eat too.

Q. How much of the range is the herd using? What size area?

A. At any one time, maybe two square miles. Over the course of a year maybe 30 miles × 120/150 miles, but hopefully Dr. Murtha's range study will tell us if the land is being properly used at this time, whether a more intensive use is possible, or whether some areas are being used too intensively.

Q. Are they herded in winter, or do they move at will?

A. In fall we have a major roundup and move them to different areas than used the preceding year. It is not close herding, just the same general area.

Q. Do you have to pay a grazing fee?

A. From the start this land was established as a reindeer preserve by the federal government, and the same situation occurs now that it is in private hands. If a land claim settlement allots the lands to a corporation and we have to pay a grazing fee, we could be priced off the land.

Q. Do the reindeer and caribou herds mix when in the same general area?

A. There is always some exchange between reindeer and herds of caribou. More so some years than other years, as, e.g., when the caribou migrate near to the reindeer herd.

Q. Do you have an industry based on hides? Is there any local tanning of hides?

A. There is a real difficulty with warble flies. We found that the best time for slaughter is February, at which time flies have ruined the hides. This year we gave away 2450 hides for sleeping robes, which is a potentially marketable commodity at around U.S. $20/30 per hide, so we are trying to lick this problem and considering research for it now.

Q. How much protection for calves is needed, and what is the nature of this protection?

A. You must take care of the calves, preventing them from straying. You can't protect them from weather. Herding requirements vary from fall to spring. But this time of the year, however, they can take care of themselves.

Q. What is the potential for expanding the range?

A. East, toward Tuktoyaktuk, may be the way to go; we will have to look. Newfoundland has expressed an interest for reindeer in Labrador, and also a couple of other communities seem interested. There is a large part of the Reindeer Preserve that is now used. The 1919 Royal Commission mentioned potential range down to Great Bear Lake; down in the area of light tree cover.

Q. How does 85¢ lb. for reindeer meat compare with the price of beef in Inuvik?

A. Steak in Inuvik is $5.00/6.00 per pound, so it is a reasonable price; beef bought by the side is probably around $3.50 per pound. Reindeer meat is deliberately kept at a low price for local consumption, because there is some inconvenience to some local people from having the reindeer industry operating there.

Q. Who sets the price of meat at 85¢ — wouldn't the market bear a higher price?

A. Its an arbitary figure, though it is largely historical — the first owner set 75¢, now we have raised it to 85¢ locally though it is a subsidized figure, and we have a higher export price for meat sold elsewhere, about four times the local price.

Q. What is the average carcass weight?

A. Steers are about 150-155 lbs. and females about 115 lbs. on average.

Q. What do you do with offal?

A. We clean it up and put it in the garbage dump. It used to be fed to the dogs of course.

Q. Is the meat hung?

A. No. It is tender and goes straight from slaughter to market.

Q. What potential has reindeer milk as a product?

A. This has been discussed as a benefit, but the problem is one of manpower. The company is stretched out doing what we are doing, so unless someone expressed that interest we can't develop it. The potential, however, is clearly there.

Q. Regarding the manpower question — are northern people interested in jobs as reindeer herders?

A. I'm always approached by young people, but they have got to know the land, so I prefer older herders. You worry about the young people out there. There is the interest, but only a few people can really do the job.

Q. If caribou moved in, who would have priority, the reindeer or the caribou?

A. I'm clear about my priorities! Reindeer are easier to look after; they are quite different animals and it has not in the past presented a major problem. The area is a reindeer preserve and reindeer have priority in law.

Q. Who pays for research? Is it borne by the company?

A. Some of the research is; in addition, we obtain grants from the Department of Indian and Northern Affairs, the University of British Columbia, and from Agriculture Canada. The business also puts in some money for research.

Q. In Scandinavia some reindeer become very tame, and it is a real problem to move them on. Do you have these problems?

A. In summer they move naturally on migration. We have no problem moving them using skidoos, and helicopters during roundup. They get used to being moved.

Q. When you corral them for slaughter, how do you decide which to kill?

A. We castrate them for steer production, and pick out some for slaughter; only some are fat, or prime for slaughter.

Q. Aren't they better (more fat) in November? Why do you kill them in February, surely they have less fat then?

A. You're right in saying the animals are loosing fat in February, but we kill them for meat in November, and at other times too, except in summer time that is. The temperature in November is −40 to −50, and there is only a few hours twilight then, together with thin ice on the lakes. The winter slaughter is preferred because that is when the winter road reaches Tuktoyaktuk. We have tried it at other times of the year and February seems better, though not ideal, for a number of reasons in our geographic location.

Q. When do cows first have calves? At what age? Do two-year old cows have calves?

A. They had better have calves! Some yearlings have calves. A fawn crop of 5,000 animals is possible on the 13,000 animals.

Q. How do you arrange the packing and distribution of the meat?

A. Distribution is handled by Canadian Reindeer Ltd. The company pays a meat packing house to butcher, wrap and attractively box the meat for sale to hotels and restaurants, etc.

Q. Could you do this aspect of the operation yourself, at Tuktoyaktuk say?

A. The company that does that for us built it's Alberta plant at a cost of $5 million about four years ago. We certainly can't justify such an investment on the numbers we slaughter. However, if the herd were to double in size and if there was a 1,000-2,000 slaughter of muskox, then we might be approaching the needed volumes.

Q. What is the percentage of cows to bulls that are sexually active?

A. We are striving toward having about 15 per cent active bulls, but right now it is probably closer to 30 per cent; we want more steers relative to breeding bulls and we will be addressing that problem this summer.

Q. Do you have research in genetics and selection?

A. Regretably no. It would be valuable of course.

Q. When castrating, do you take antlers off at the same time, and what about breeding bulls, do you take their antlers off too?

A. Yes, we take antlers off breeding bulls and it doesn't interfere with their performance.

Q. Of 3-4,000 calves, how many die and what are the causes of death?

A. We don't have statistics I can quote you. The survival rate is good in good weather; if it is wet and cold we loose a lot of fawns. At this time of year herders are with the herd to look after calves, and will stay with them till May; this has had a dramatic effect, and I guess the survival rate is probably 85-90 per cent.

Q. At what age do you slaughter?

A. We don't do it by age; when we look at them we know which ones to kill. When we harvest in February we mainly take females, the breeding bulls are not too fat at that time of year.

Q. Do you have a meat inspector present at the time of slaughter?

A. Yes we insist on a veterinarian being there. We slaughter with a .222 calibre rifle near the slaughterhous. This year we managed 269 in one day; the earlier record was 107 in one day. With the new slaughter facilities we anticipate being able to slaughter 400 a day next year.

Q. How many employees do you have?

A. There are six herders; they rotate, so that four are on duty at any time, then there is William, and his wife (as bookkeeper), 40-50 people in summer for 2-3 weeks, and 20-22 people for the winter slaughter for a month. There are associated contract services: e.g., summer roundup uses 2 Jet Ranger helicopters, a Cessna 207, and a Twin Otter aircraft is used occasionally. Some other local employment spin-offs too, and Dr. Billingsley is retained as a part-time consultant.

Q. Do you arrange transportation of meat, or does the customer have to arrange the pick-up?

A. The whole operation is the responsibility of the Canadian Reindeer Company. The customers pay f.o.b. Inuvik or Edmonton say, and the company delivers the product.

Q. Could the reindeer go into the wooded areas? What effect might this have on the operation?

A. I have no experience of this, so can't say. It might take more care. I'm sure it would be possible, there is always a way.

Q. Do you know other areas of the N.W.T. where herding could take place?

A. We don't know; we hope that the remote sensing work will show us the winter range. There have been other attempts (to introduce reindeer) in earlier times, e.g., one near to Frobisher Bay, another near Great Slave Lake, and the Grenfell Mission's efforts in Labrador. The problem is the attitude change that is required to go from hunting to husbandry. That seems to have been the main problem in the past.

Q. Aren't the herders getting old now? Are there young people coming along to do the job?

A. One herder has been there 35 years; other come and go, we have some (new herders) learning from the older ones.

THE ALASKA ESKIMO WHALING COMMISSION AND ITS RESPONSE TO THE CHALLENGE OF RENEWABLE RESOURCES AND THE ECONOMY OF THE NORTH

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It is a pleasure for me to represent the Alaska Eskimo Whaling Commission (AEWC) at this International Symposium on Renewable Resources and the Economy of the North. There are several issues which I would like to bring to the attention of those attending this symposium. These are:

1) The Alaska Eskimo Whaling Commission assures their interest in this and future circumpolar meetings.

2) It is their hope that Alaska will be the host country for the next meeting.

3) The AEWC wishes to express its opposition to international control over subsistence resources — local control should be the priority.

In recent weeks in Alaska we have seen a complete change in attitude by the Federal government regarding the bowhead whale. Just a few short months ago (October) some of the whaling captains were indicted for overharvesting the bowhead whale. Today, these charges have been dropped, and the National Marine Fisheries Service has turned the bowhead counting and other problems over to the Alaska Eskimo Whaling Commission.

The Commission has considerably expanded its scope beyond the bowhead and is one of the main reasons for my attendance at the Symposium. I will tell you in a few short paragraphs how the AEWC got started, what it has done and what it hopes to accomplish regarding marine and related studies on the North Slope.

First, it is important to recognize that the native population in all of Alaska not only has voting power in the state, it also has elected representatives in the State Senate and House. The people of the North Slope Borough also have a high sense of value and concern for their land and culture.

The Alaska Eskimo Whaling Commission has expressed interest in assessing social, economic, and environmental impacts of industrial development on the North Slope of Alaska. To provide for formulation of strategies to soften those impacts, the AEWC desires to improve the information base necessary for timely management and decision-making. Primary to fulfilling its present needs is further information relating to present status and ecological requirements of the bowhead whale. The AEWC already has cooperated in a number of research programs on the bowhead whale and has recently conducted its own research effort. The AEWC always has sought consultation and advice for the design of environmental research programs. Recently, it has expressed a desire to for-

malize this procedure through a Science Advisory Committee reporting to the Chairman of the AEWC.

In order to meet that need, an organizational meeting was held at the University of Alaska, October 23 and 24, 1980, to establish a Science Advisory Committee and to define its goals.

When requested by the Alaska Eskimo Whaling Commission (AEWC), the Science Advisory Committee (SAC) would:

1. Advise the AEWC in the development of research plans relevant to the protection of subsistence species and the marine environment.
2. Assist in development of research proposals and requests for proposals to satisfy the needs for sound scientific information required for the decision-making process.
3. Assist in identifying potential environmental problems related to industrial development.
4. Provide appropriate peer review of research proposals.
5. Provide for the review of AEWC technical reports.
6. Assist the AEWC by providing or recommending liaison or representation at scientific meetings or conferences.
7. Assist the AEWC in evaluation of the progress and quality of their funded research projects.
8. Assist in the development and coordination of science training opportunities when possible between the AEWC, local, federal, state agencies, and industry.

Recognizing that Native people have a strong awareness of the importance of the ecosystem of this polar region, particularly with respect to seasonal variations in the physical environment and to the habitats and behaviour of the marine fauna, and that each part of that system interacts with the other parts, it is recommended that:

1. The AEWC research program address this area of the Arctic as an endangered ecosystem which includes man, as well as other species of cultural and subsistence importance to the Inupiat people.
2. Because of the immediacy of offshore industrial development in this area, the marine system is of highest priority for study.
3. Within the marine system, emphasis should be placed on the bowhead whale and its environment. For example, much more information is needed on:
   a. The size of the bowhead population and its sex/age composition. In this connection, studies of age determination are needed to relate age to size (length) of individual whales, since estimates of population composition will need to be based on the comparative size of individuals.
   b. Reproductive data, such as age at sexual maturity, time and place of mating and calving, birth rate, and length of reproductive life.
   c. Trophic relations, including kinds and quantitites of food organisms eaten and their distribution within the system in space and time. On what oceanographic conditions are these food organisms dependent for their production and survival?
   d. Causes and amounts of natural and man-induced whale mortality, as well as harvest mortality, in relation to time, place, and the age/sex classes affected.
   e. The influence of ice and weather conditions on the migration and distribution of the whale.
   f. Natural and man-made stresses affecting the whales.

g. Possible harmful effects of man-made noises in the arctic marine environment and the short- and long-term behavioural relations of marine mammals to these noises.
h. Investigating the movements and behavior of whales. New remote sensing techniques for tracking whale movements should be sought.

4. Further research should be encouraged and accomplished to improve weaponry and minimize loss of bowheads during the subsistence harvest.

None of this information will be quickly or easily obtained, and all of the studies should be coordinated with those of other federal, state, and industrial research programs to avoid duplication of effort and to encourage maximum returns from funds and manpower. Some projects will require a large amount of motivation and new technologies in order to improve the data-base of marine mammals and other organisms already available.

It is further recommended that:

5. Research addressed to environmental threats include not only direct effects of crude oil spills but the combined effects of other environmental disturbances, especially during critical life stages of subsistence animals and their food organisms. The AEWC should be prepared to take advantage of research opportunities quickly, at the time of environmental threats such as accidental chemical or petroleum discharges into the marine environment.
6. Socio-economic studies should be continued and encouraged to assess possible impacts of commercial development on Alaskan Native communities and to provide information to decision-makers that can be used to soften those impacts should they occur.
7. Periodic conferences should be held for the purpose of synthesizing available multidisciplinary information suitable for making reasonable management decisions. Information synthesis should be an early goal of the AEWC research program and should include AEWC efforts as well as those of other agencies. Synthesis efforts may be useful for estimating future environmental impacts.
8. The AEWC should sponsor research projects relevant to its specific needs and suggest other research topics to be carried out by other agencies and research groups.
9. The AEWC should work with the North Slope Borough School District, other whaling communities, the University of Alaska, and/or other accredited colleges and universities to provide additional post-secondary training in the environmental sciences and related scientific management.
10. The AEWC should actively seek an adequate research support facility by encouraging the reopening of the Naval Arctic Research Laboratory or construction of an alternate facility at some convenient location.

As you can surmise from my comments, there is considerable interest in seeing that research continues toward understanding the renewable resources of the North.

NATURAL RESOURCES AND HUMAN ACTIVITY IN NORTHERN FINLAND IN POST-WAR TIMES

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Finland as One Part of the Circumpolar Region

Finland is located between the latitudes of 60° and 70°N, with a good third of its surface area north of the Arctic Circle, although by virtue of the Gulf Stream, conditions for human activity in Fennoscandia, and in Finland as one part of it, are much more favourable than elsewhere at comparable latitudes. As may be seen from Fig. 1, the mean July temperature at a latitude of approx. 65° is around 15°C, while that for February is −12°C and the thermal growing season is approximately 145 days a year (Siuruainen 1972: 18). The length of the country from north to south, some 1100 km, nevertheless causes considerable differences in physical conditions.

The majority of Finland falls into the boreal coniferous forest zone, and the limits of spruce, *Picea abies*, and pine, *Pinus silvestris*, cross the northern part of the country, with a zone of mountain birch, *Betula tortuosa*, extending beyond, together with a tundra vegetation zone on the higher ground (500-1000 m). In turn, the southernmost tip of Finland forms part of the Central European deciduous and mixed forest zone. Production of renewable (living) resources is significantly higher in the south than in the harsh areas of the north, and these differences are reflected very markedly in the conditions for human activity in the respective regions.

Finland has a surface area of 337,000 sq. km about nine per cent of which is accounted for by waterways, 57 per cent by forests, eight per cent by cultivated land and 26 per cent by wasteland, built-up areas and roads. The population is 4.6 million, and the mean population density 14 people per sq. km. The majority of the population lives in the southern and central parts of the country and along the coast of the Gulf of Bothnia. Northern Finland is regarded as comprising about one half of the total area of the country, but contains only 13 per cent of the population. About two-thirds of the population of the country as a whole live in the towns and other built-up areas. The age structure is typical of the industrialized countries, with the rate of natural increase slowing down generally and declining sharply in many rural areas as a consequence of selective out-migration.

Finland is the northernmost country in the world in which agriculture is practised throughout. In the 1950's one half of the population still made their living from agriculture and forestry on small privately-owned farms. By 1975, however, only 12 per cent did so, compared with 21 per cent from industry, eight per cent from construction, 20 per cent from the service industries and about one-third from other sources, principally pensions, social assistance, etc. The shift of population from agriculture to other occupations has been accelerated by the higher income levels offered, the shorter working hours, the easier work involved and better accessibility. Looked at from the point of view of agriculture itself, the principal reasons for the loss of population from the 1960's onwards may be seen

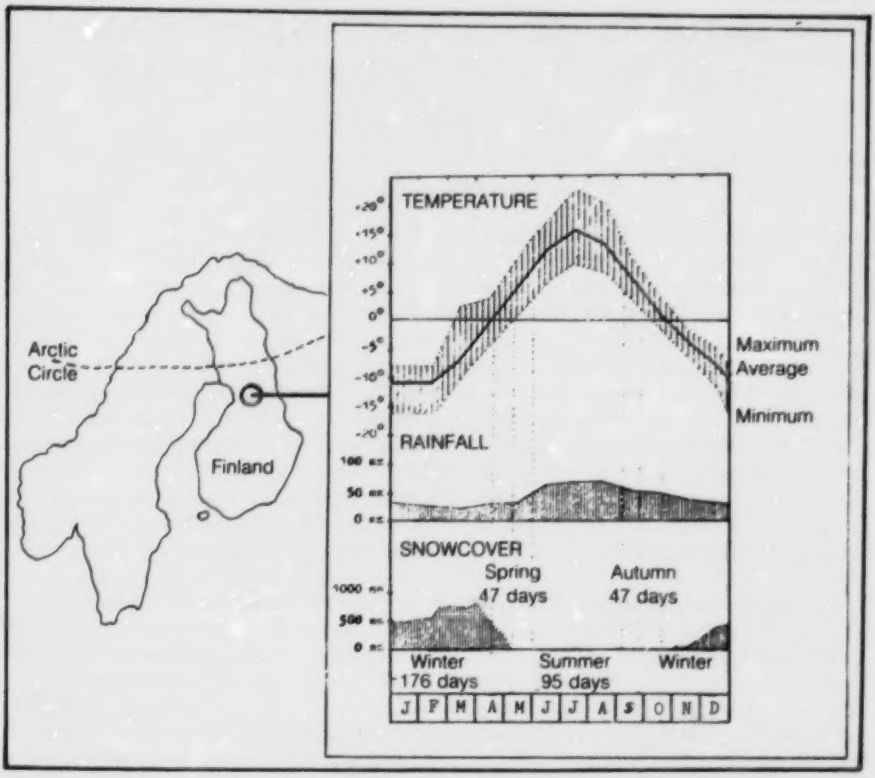


Figure 1. Climatic conditions in Pudasjärvi, (65° N) in Finland.

to lie in the low esteem in which this occupation is held and, more particularly, in the gross overproduction of the major agricultural products, milk, butter, cheese, meat and eggs, in relation to domestic demand. The high production costs make it difficult to compete in the export market, and grain, for instance, is only stored in Finland for a very short time.

Government aid for the extension and intensification of agriculture has been available ever since Finland became independent in 1917, and a major effort was made in the 1940's to settle some 500,000 refugees, men released from the forces and the post-war bulge generations in productive work on new farms set up largely on state lands. These farms were mainly located in sparsely populated areas, where the owner himself was required to clear the fields and construct the buildings and was also granted rights over an area of forest. This state aid for the clearance of agricultural land continued into the 1960's, right up to the time of the over-production problem (see Siuruainen 1978: 67-77). After a policy of promoting agricultural production and creating jobs in agriculture, the government was suddenly forced to support quite opposing policies in order to reduce agricultural production. Thus a law was passed in 1969 allowing farmers to be paid compensation for leaving their fields fallow and bounties for the slaughtering of dairy cattle and poultry with the aim of reducing stocks. The present subsidies paid by agriculture itself towards the costs of exporting agricultural products similarly serve as a measure for reducing production.

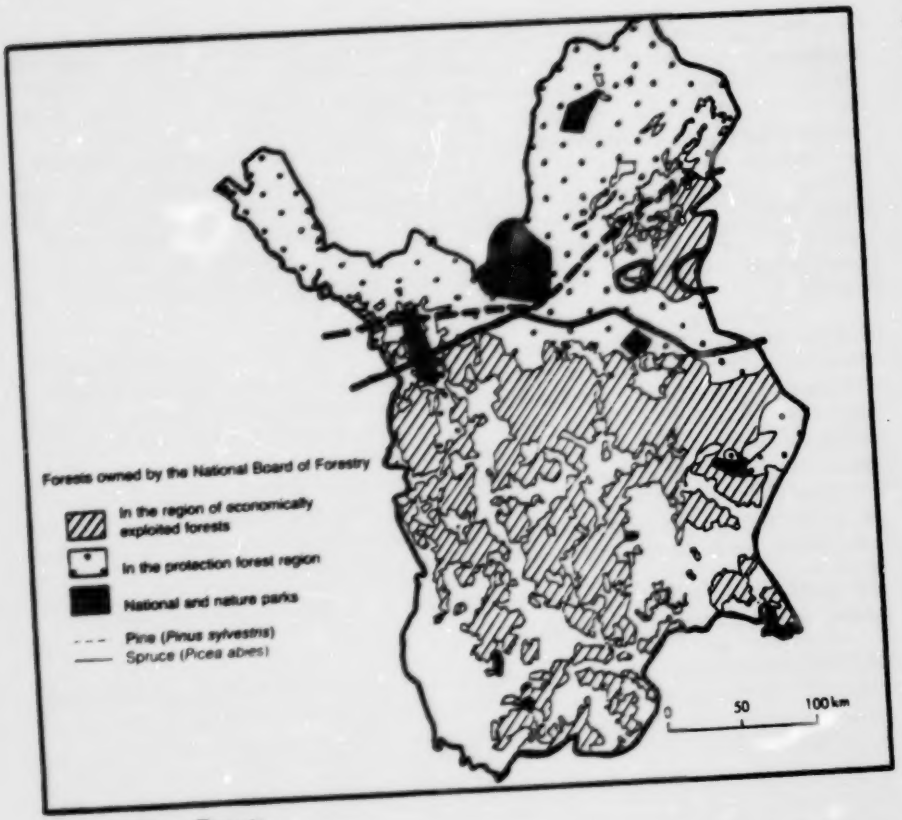


Fig. 2. State Forests.

The sharp reorientation away from a farming nation and towards a society characterized by the industrial and service sectors has taken place so rapidly that the increase in employment in these other sectors, even as a mean figure over the whole country, has not been able to keep pace with the size of the labour force changing occupations or reaching working age. Growth in the numbers of jobs in industry has been typical of the southern and south-western parts of the country and the major centres in the north, while a pronounced increase in the tertiary and quarternary sectors has created new jobs in the centres at various levels. The greatest movement of population away from agriculture and forestry in relative terms has taken place in the more remote districts of northern and eastern Finland, where the young people of working age in particular have found their way to the local commune or provincial centres, or to southern Finland, or even to Sweden. Altogether about 350,000 people from Finland have moved to Sweden during the last decades, either temporarily or permanently, in search of work, mostly from the north and east. This rapid social process during the 1960's and the 1970's has had a pronounced effect on the employment situation and the development of social infrastructures. Mean unemployment over the whole country has increased to six to eight per cent, partly for this reason and partly on account of automation, but there are many places in the rural districts of the north and east where up to 20-30 per cent of the labour force are unemployed in the winter.

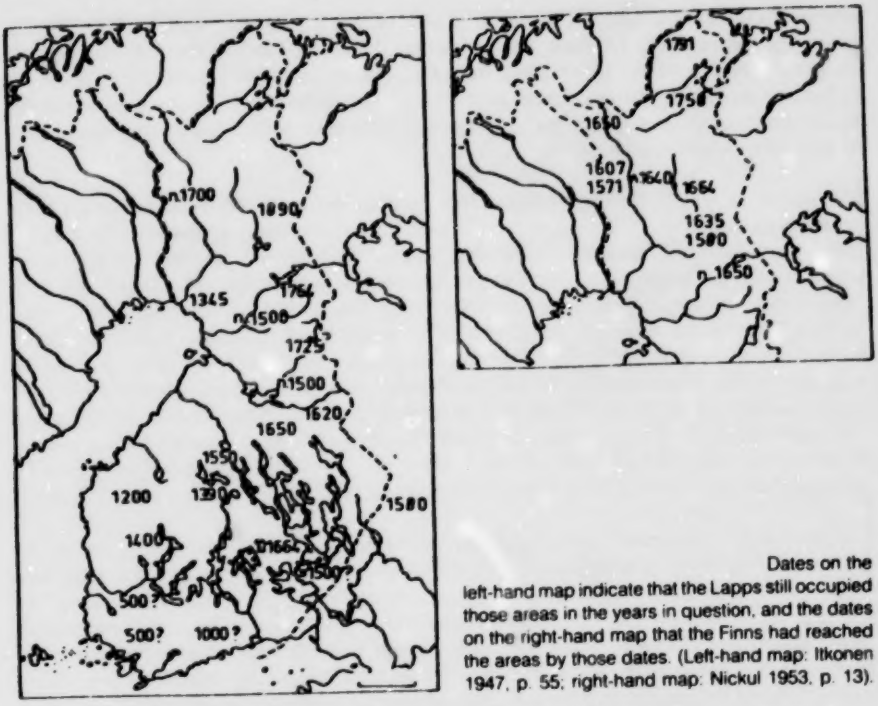
In spite of these social changes, the average standard of living of the Finnish people has continued to rise, and the national per capita income in 1976 of US$ 5620 per annum is among the highest in the world. Similarly the mean annual increase in this figure during the 1970's was of the order of 3.5 per cent. Practically every citizen is assured of accommodation, education, health and medical servies and rights under social legislation, and assistance is provided for children, the unemployed and the aged. The average material affluence of the people is now at a higher level than ever before. Efforts are also being made to even out the regional differences in economic and social opportunities by means of regional policy legislation, with the aim of encouraging new openings for employment and improving the level of services in the eastern and northern parts of the country.

Despite these efforts, the northernmost regions of Finland still lag behind the national standards in their economic and social circumstances. At the same time the difficulties encountered in the traditional primary sector occupations and the slowness with which any alternative sources of livelihood present themselves will tend to increase the uncertainty felt by the people of this area concerning their future. This part of the country is generously endowed with natural resources in relation to its population base, and these have been exploited effectively within a short space of time, but the benefit obtained from them has mostly accrued to the country at large, while the inconveniences resulting from their exploitation are borne most heavily by the local population.

Developmental Problems of Northern Finland in Relation to the Problems of the Extreme North in General

The northernmost areas of North America, Europe and Asia are undergoing far-reaching changes. The economic interests of the respective states are spreading rapidly towards those marginal areas, and the original inhabitants such as Inuit, Yuit, Indians, Lapps, Samoyeds, Yakuts, Tungus, etc. have been subjected to powerful pressures of acculturation (see Graburn & Strong 1973; Baird 1964). At the same time their living space is continuously being reduced as the land, forests, waterways, ore deposits and oil and natural gas resources are taken over for intensive exploitation by the majority population and the natural countryside is appropriated for recreational purposes. These major economic and social changes have indeed affected not only the cultural minorities, but also the remainder of the local population, and have caused confusion, adaptation difficulties and uncertainty about the future among both groups. The earlier ecologically-based ways of life are disappearing and the new way of life has failed to offer a durable alternative which will ensure a long term source of livelihood.

The northern parts of Fennoscandia have been inhabited "from time immemorial" by the Lapps, or Sàmi, of which there are, on present calculations, at least 37,000, of whom 20,000 are located in Norway, 10,000 in Sweden, 5,000 in Finland and 2,000 in the Soviet Union. With the northward spread of the majority population within Finland (Fig. 3), a good deal of intermixing of the two peoples has taken placing in both directions at the points of contact, and the Lapp population has been forced to retreat to its present area, largely as a consequence of the exhaustion of game stocks and the practice of "slash and burn" cultivation customary among the early Finnish settlers. The traditional way of life of the Lapps is based on hunting, fishing, the gathering of the fruits of the earth and herding of the semi-domestic reindeer, with the rhythm of life being determined by the ecology of these pursuits. Thus the ecology of the reindeer, for instance, led to extensive seasonal nomadic migrations between the inland fells and the coasts of the Arctic Ocean (see Manker 1945).



Dates on the left-hand map indicate that the Lapps still occupied those areas in the years in question, and the dates on the right-hand map that the Finns had reached the areas by those dates. (Left-hand map: Itkonen 1947, p. 55; right-hand map: Nickul 1953, p. 13).

Figure 3. Known extent of Lapp and Finnish settlement at various times.

The increase in the population of the Lapland region naturally intensified the exploitation of its natural resources, as also did the extension of trading connections, involving such activities as fur trapping. Similarly people from areas as far away as central Finland would undertake fishing expeditions to Lapland, even to the coasts of the Arctic Ocean in years in which the crops had been affected by frost damage, often assuming the characteristics of a plundering raid. By the turn of the last century the numbers of bears, wolves, lynx, foxes and wildfowl had declined abruptly, and the Lapps' principal game animal, the wild reindeer, and the beaver (trapped for its fur), had been wiped out altogether in the region. It thus became necessary to adapt gradually a way of life based on reindeer herding, agriculture, forestry, and later, to modern trades of various kinds. Contacts with the majority culture led to more efficient exploitation of the natural resources and a greater compunction to take up peasant occupations and adopt a monetary economy. During the period of change it was even common for the local people to sell their annual supplies of food to obtain the new commodities offered by the majority culture. The direct relationship with nature began to collapse, and was replaced by the values and norms of the monetary economy, even among those of the original inhabitants living in the most remote areas.

The Population of Finnish Lapland and the Exploitation of the Area's Natural Resources

Up to 1969 the population of Finnish Lapland had grown steadily as a result of immigration and the high rate of natural increase. One consequence of the large-scale settlement

activity following the Second World War was indeed a constant extension of the areal model for settlement in Lapland, which continued into the 1960's, after which a decline set in as people began to move away from the primary production sector. It is possible, in fact, to recognize distinct phases in the history of settlement in the area in which the development of the population and its way of life has been influenced by the exploitation of different natural resources.

The period in which the Lapps themselves enjoyed the exclusive right to pursue their natural way of life was followed in the 17th and 18th centuries by a movement of Finnish settlers into the area, attracted by the vast hunting grounds and plentiful fishing waters which it offered, and also to some extent by the possibilities for agriculture. The subsequent century saw an increase in the value of the forests in Lapland, and timber began to be felled for the sawmill companies. The growth in the timber industry and the annexation of the Petsamo district from Russia meant a major increase in the population of Lapland. The connection to the sea via Petsamo was relinquished, back to the Soviet Union, in 1945. The Second World War as a whole probably influenced the development of Lapland as it is today more than any other single event, since it led to the destruction of practically every house north of the Arctic Circle, with the population having to be evacuated on several occasions either to the central parts of the country or to Sweden.

The post-war reconstruction work and the widespread felling of the forests led to an increase in the population again, and also offered abundant opportunities for a transfer from a natural economy to wage employment. This rebuilding of the infrastructure in Lapland lasted into the 1960's. One additional factor which has influenced demographic development in the area has been the harnessing of many of the major watercourses for hydro-electric power (Fig. 4) to feed into the national electricity grid. The large-scale exploitation of the natural resources of Lapland has slowed down considerably since 1970, leaving a population of about 200,000 still engaged in a bewildered search for means of ensuring their future livelihood. The progress of development from the natural economy of the original inhabitants up to the present day thus features phases such as the decline in the economic significance of the area's game resources, the decline in fish stocks due to over-fishing and regulation of the watercourses, widespread clear-cutting of the forests (even in the areas of protected forests) and draining of many mires rich in wild berries to allow a meagre growth of forest, the dividing up of the reindeer grazing lands into smaller reindeer herding districts, and the drift of population away from the practice of agriculture, which had been begun with such verve and had received such vigorous government support. These have been major changes and have taken place over a very short time, and their effects will no doubt be seen for a considerable time to come as the natural environment works its way back to a state of ecological balance and the people seek new opportunities in order to guarantee themselves an adequate livelihood in the future.

Human Influence on the Natural Resources of Lapland and Future Exploitation Prospects

The majority of the land area in Lapland is owned by the Finnish state (Fig. 5), and the access which the local people have to their natural resources is thus largely dependent on the measures adopted by the National Board of Forestry, which is responsible for the administration of this land in practice. The felling operations begun in the 1950's, for instance, brought about major changes in the natural environment, changes which continue to be reflected in the economy of the local people even today. It was estimated, for example, that in 1953 the forests of Finnish Lapland contained some 310 million cu m of

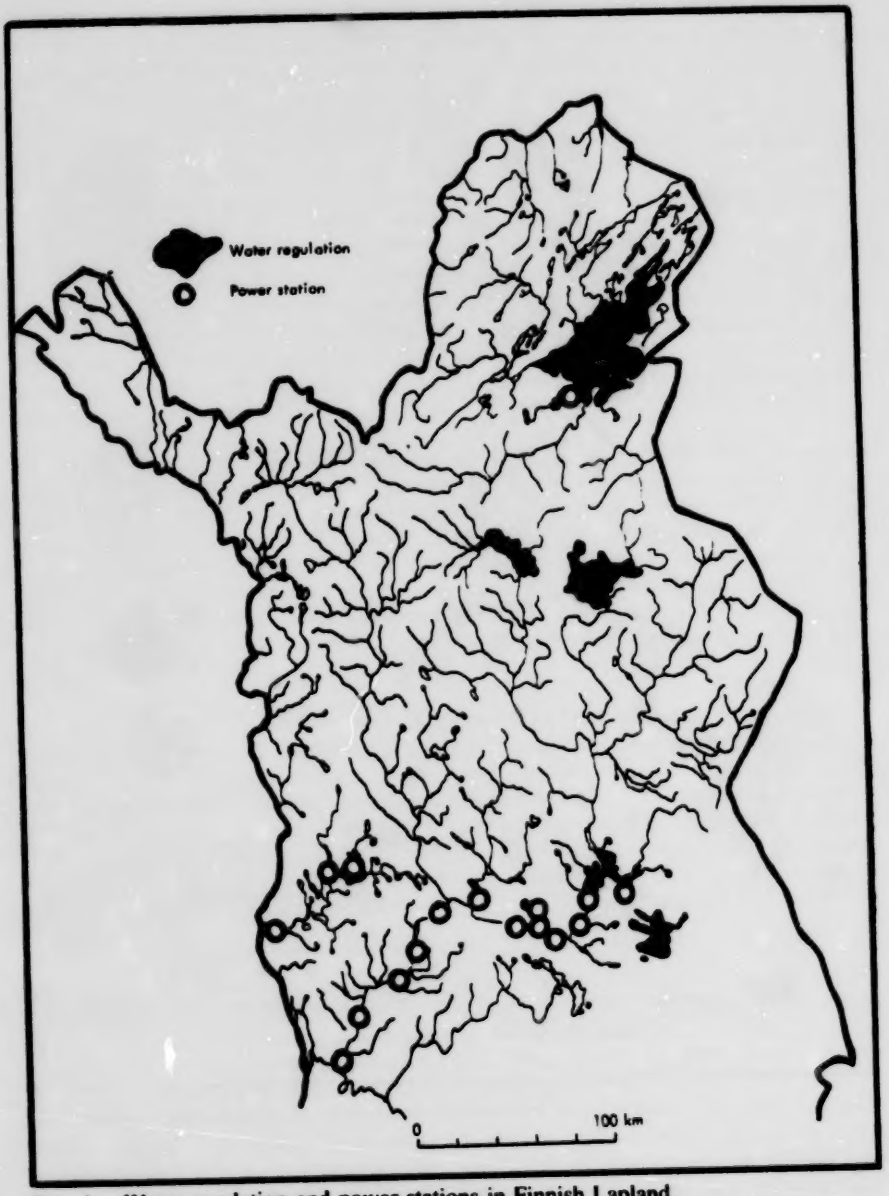


Fig. 4. Water regulation and power stations in Finnish Lapland.

timber, a figure which had declined to 269 million cu m by 1970 as a consequence of the extensive felling. Also the forest limit in the north has been shown to have shifted some way further south on account of felling in the zone of protected forest, and regeneration in many felled areas has been hampered considerably by incompetent forest management.

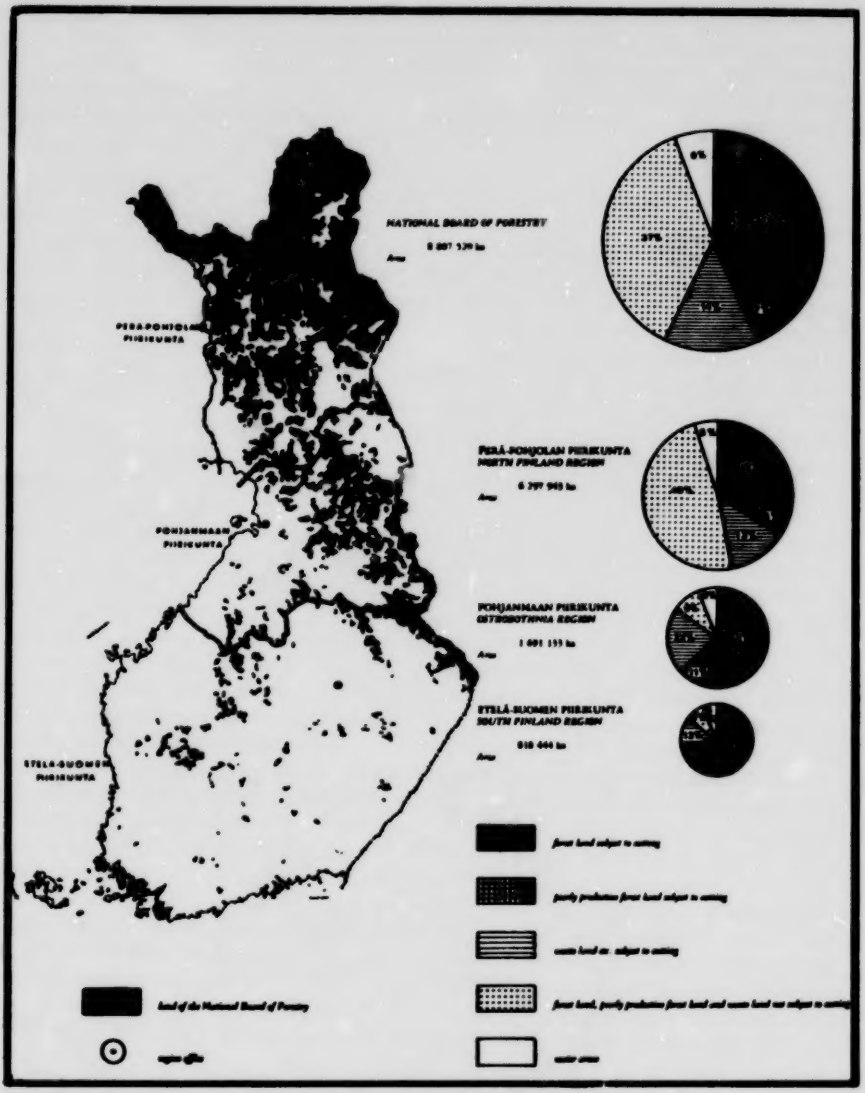


Fig. 5. Land and Water areas of the National Board of Forestry at the beginning of 1977.

The seed of these trees only succeeds in ripening properly in exceptionally favourable years at this latitude on account of the harsh climate, perhaps only a few times in a century, and seed and saplings imported from the south of the country have been found to have a high rate of growth deficiencies. It is also estimated that at least 420,000 ha of clear-cut forest has failed to regenerate at all, which in the long term may simply increase the pressure for the felling of more trees in the protected zone in order to guarantee a supply of raw materials to the wood processing mills in Kemi and Kemijärvi.

Similarly the stock of dead standing pines which had accumulated in the forests of Lapland over several centuries has been severely depleted within a short space of time for the buildings of holiday cabins etc. over the whole of Finland and even abroad. This very valuable building material is now becoming scarce in most places, except for the most remote tracts of forest where transportation is difficult. Stands of deciduous trees were more or less destroyed in connection with the felling of coniferous forests at the time when oil was a cheap commodity, since they represented timber of practically no economic value, whereas their importance as an energy source has increased greatly in recent years.

The many experimental measures used in trying to improve forest regeneration have created problems for the balanced development of the natural environment in Lapland. Preparation of the ground in felled areas, scalping and ditching at three to five metre intervals has failed to promote the desired rates of sapling growth, and the removal and stacking of the thin humus layer has changed the aspect of the surface vegetation and in many places promoted the spread of erosion and reduced the value of the reindeer grazing grounds (see Saastamoinen 1977: 124-127).

A third of the land area of Lapland consists of mires, chiefly treeless aapa fens or pine bogs with stunted forest. These mires are an essential feature of the landscape and serve both as grazing grounds for the reindeer and a sources of berries such as the cloudberry (*Rubus chamaemorus*) and cranberry (*Vaccinium oxycoccus*). The gathering and sale of cloudberries in particular contributes an important part of the annual income of the local inhabitants. It is estimated, for instance, that about 80 million Fmk* was earned in this way in 1976 over the whole country, the majority of this sum coming from Lapland. Since the cloudberry is a "social berry" the highest incomes can be obtained by families with children.

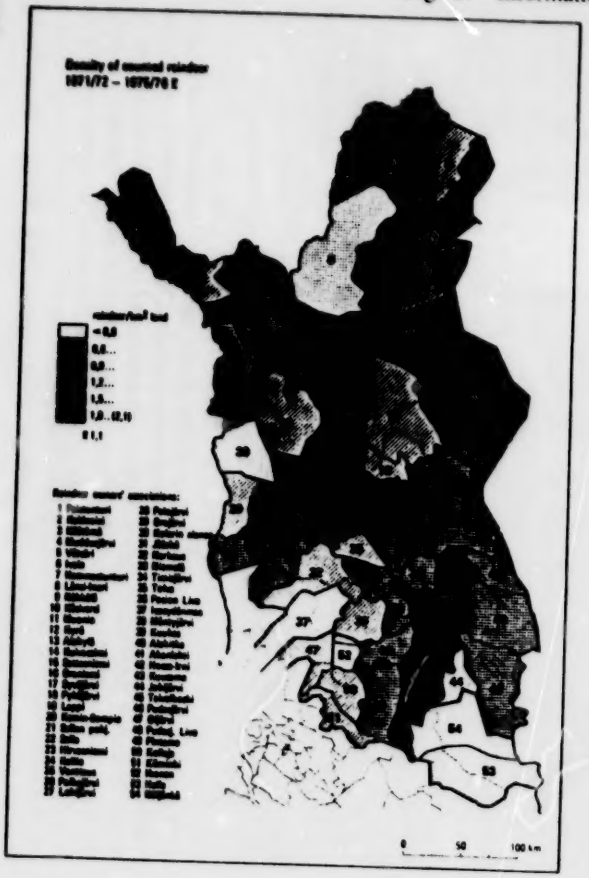
A significant proportion of the mires of Northern Finland have now been ditched to improve forest growth, causing them to dry out gradually and destroying their cloudberry plants. On state lands this increased forest growth has accrued to the forest owner, the state, at the expence of the local population whose income from the berries has dwindled or come to an end. Since the work of felling has now been given over to full-time lumberjacks assisted by powerful machinery, the local people have even lost this opportunity for additional employment. One attempt to correct this situation has been the limitaton of cloudberry-picking rights to the local population in the communes of Northern Lapland.

A further effect of the large-scale ditching of mires in Northern Finland in general has been to increase the humus content of the water in the usually very shallow lakes, which in turn has affected the oxygen balance in the water during the long winter period. Both the regulation of the water levels and the change in water quality have interfered with the development of the commercially exploitable fish populations.

The abundance of good fishing waters in Lapland formed the basis upon which many people obtained a living in the past, and the River and Lake Lapps developed their economy largely around the fishing of various salmonids. This natural fishing has declined markedly in recent times, however, with the harnessing of all the main rivers except for the Teno and Tornio rivers for hydro-electric power. Local opinion is that the waters are now badly over-fished and that the regulation measures have led to an increase in the

*Editor's Note: Approximately US$25 Million.

Fig. 6. Information on reindeer ownership and production.



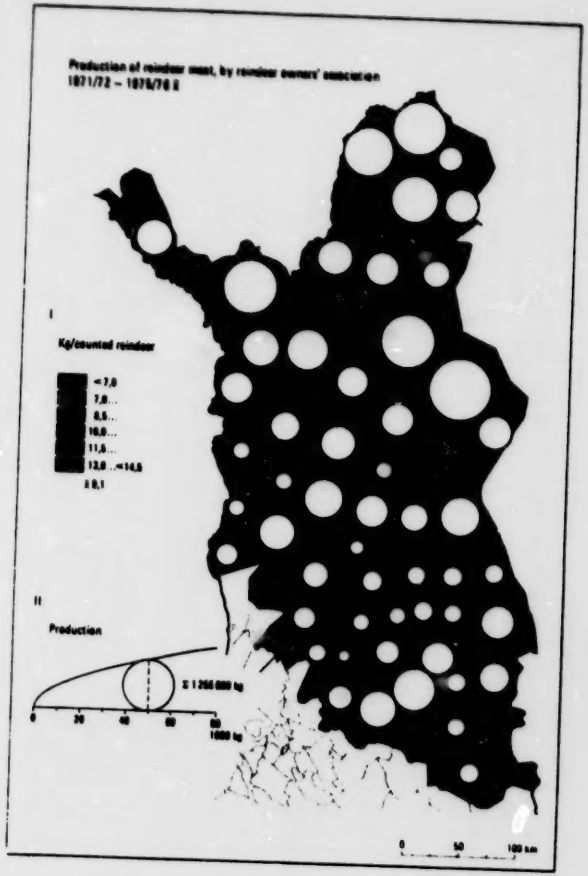
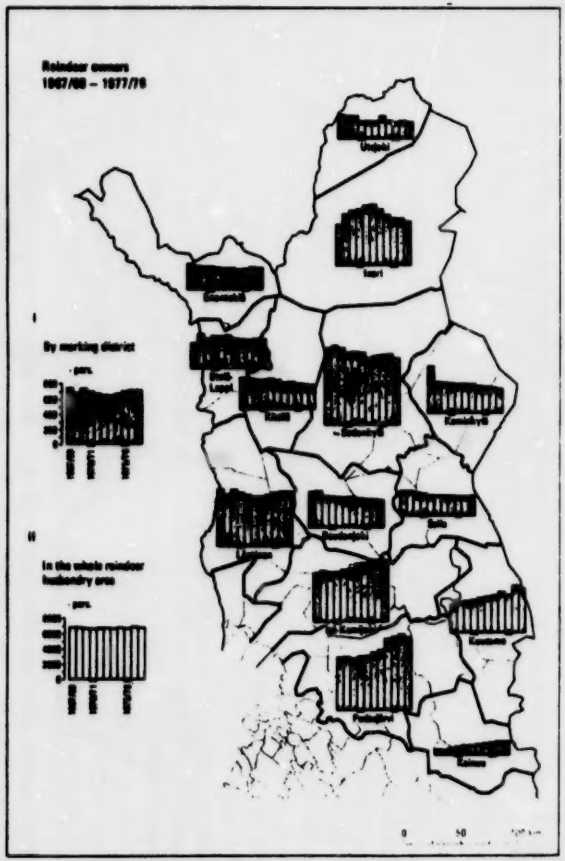
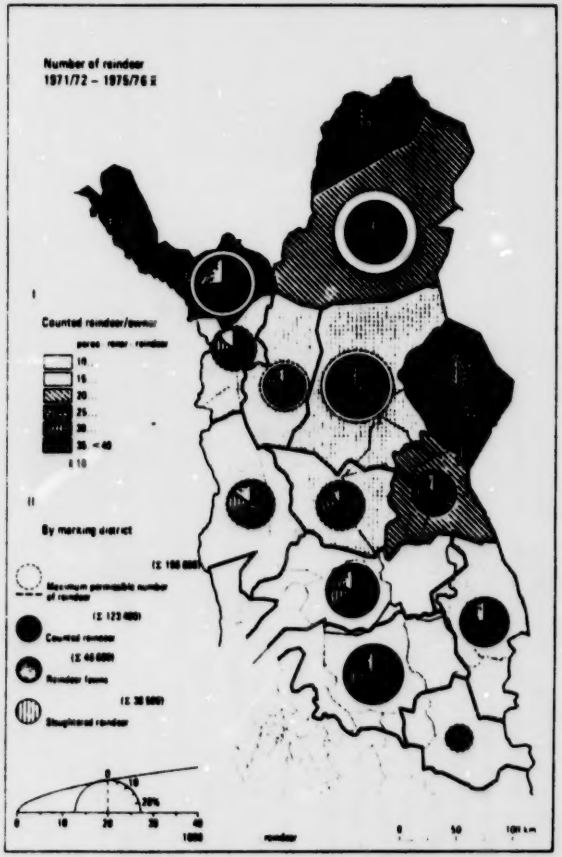


Fig. 6. Information on reindeer ownership and production.





proportion of fish of less commercial value, e.g. pike, perch and burbot. Whitefish have been introduced into the reservoirs of Porttipahta and Lokka in central Lapland, and have been quite successful. Lapland had a total of about 120 natural fish-rearing ponds in 1978, maintained chiefly by the state, various institutions under legal obligations to do so, and private individuals. Similarly there were approximately 1000 professional fishermen in the area in 1976, although only about eight per cent had this as their principal employment (Atlas of Finland 1980). Regulation of the watercourses has also made reindeer herding more difficult and the extensive reservoirs that have been set up have forced many families to abandon the lands they traditionally exploited.

The movement of Finnish people into the traditional Lapp areas has gradually brought about a change from nomadic reindeer herding to a system based on permanent settlement and established reindeer herding districts, of which there are 54 altogether in Northern Finland, each with its own reindeer stocks (Fig. 6). As the Lapps in particular see the problem, this system, which was set up at the end of the last century, infringes against the former ecologically-based style of herding: the boundary fences restrict the movements of the reindeer and the already sparse grazing areas become trampled and destroyed. The constant increase in the density of road networks, the deterioration of winter pastures due to the felling of the forests and the steep rise in the costs of reindeer herding have led to a weakening in the position of this traditional economic activity, and at the same time have made it more difficult to maintain the traditional way of life and Lapp culture.

One reason for the rise in the costs of reindeer herding lies in the adoption of technical aids. The old way of herding, moving on foot or on skis and using dogs, created a great deal of employment and was relatively inexpensive, so that a family could obtain a good part of its annual income from even a quite small herd of reindeer. From the early 1960's onwards, however, it has become more and more common to follow the reindeer by snowmobile (Fig. 7), tractor, motor cycle or car, the acquisition of which vehicles would require annual returns from a herd of at least 20 animals. Thus the change in herding methods has served to reduce numbers of small reindeer owners, and in the absence of alternative work has correspondingly added to unemployment. Similarly traditionalists among Lapps and in the more remote country districts are by no means agreed upon the advantages and disadvantages of such expensive technology.

The overwhelmingly small-scale agriculture of Lapland (see Varjo 1974) reached the peak of its development in the 1960's, when the mean field area per farm was five to seven hectares having about the same number of dairy cows. This would in turn provide a living for a family of some five to seven people, with the majority of monetary income coming from outside work in the forests, in timber floating or in the construction of buildings or roads, together with the sale of timber from the farm's own forests, generally totalling some 100-150 ha. Again the low level of mechanization led to considerable demand for human labour even on small farms. This combination of farming and ancillary occupations formed a way of life which guaranteed an income all the year round and included short rest periods when changing from one form of employment to another. By the mid-1960's, however, a change had set in in the way of life even among the people of Lapland. In the case of agriculture, this was brought on by the national measures taken to reduce over-production, together with the rise in costs and the desperate need for rationalization. The long working days and the very much lower mean level of incomes than was obtainable in the industrial or service sectors also contributed to the abandonment of farms.

The conditions of life of the inhabitants of the northernmost parts of Finland have been affected by an increased dependence upon external factors. Obtaining work will become

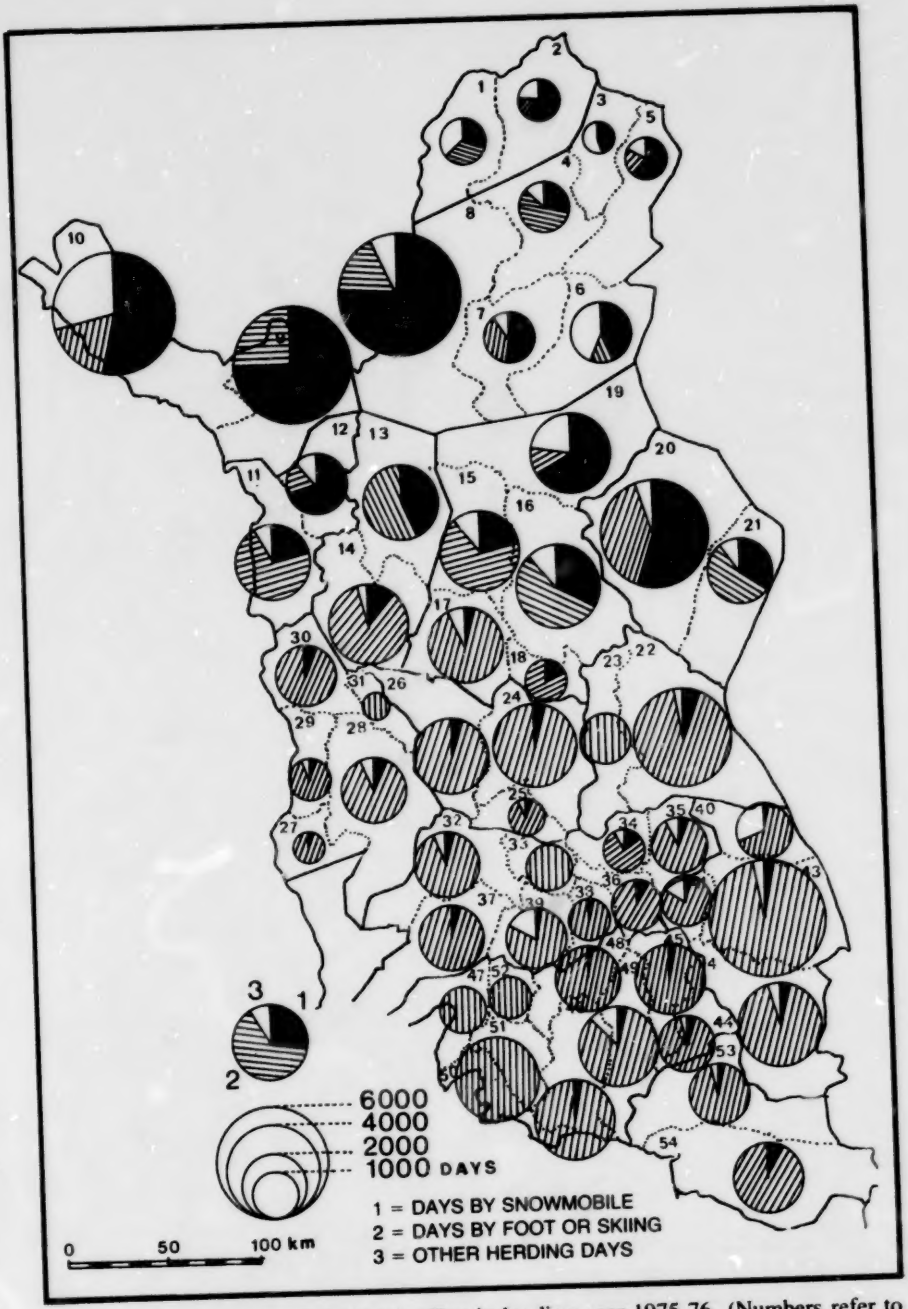


Fig. 7. Days worked at Reindeer herding in herding year 1975-76. (Numbers refer to districts in Table 1).

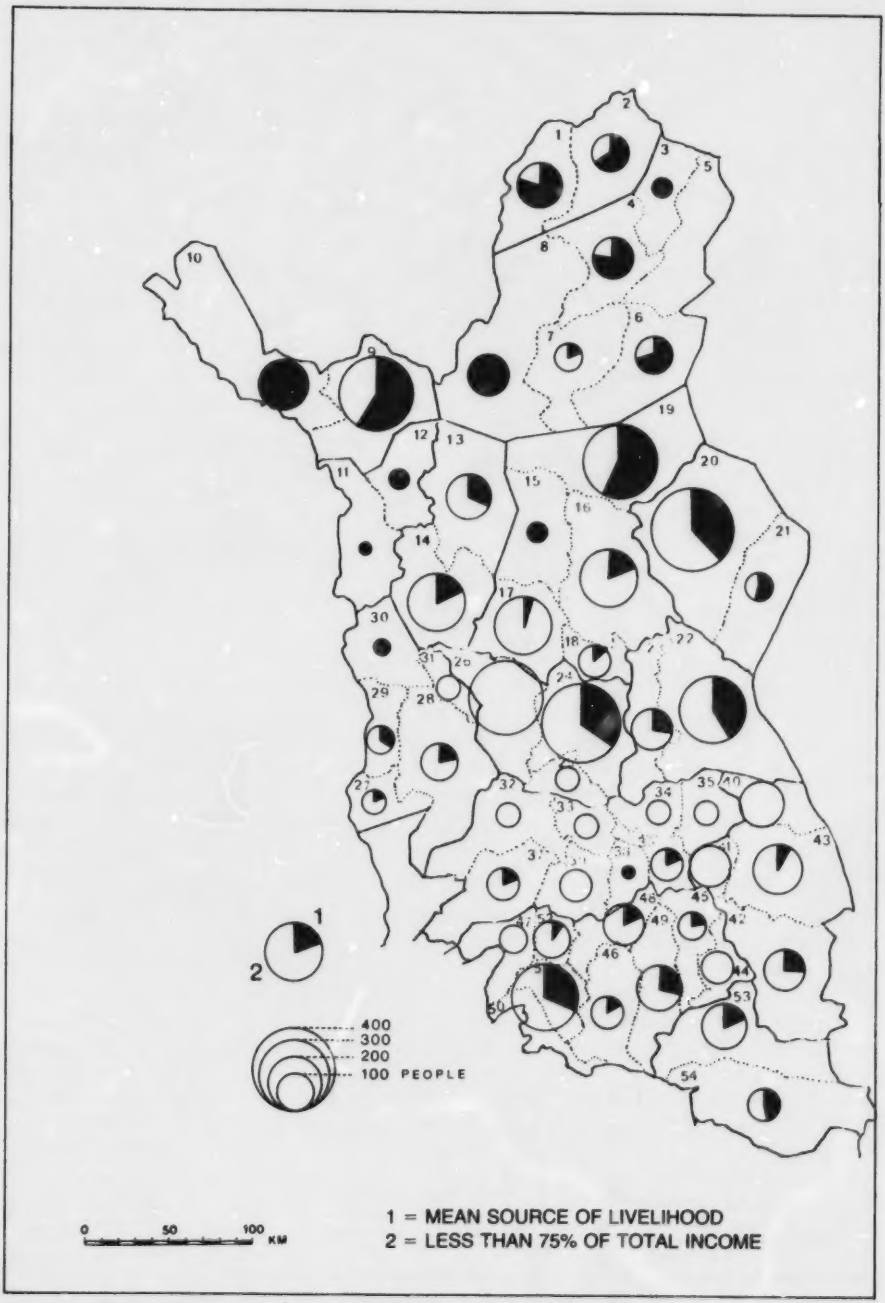


Fig. 8. The importance of reindeer herding as source of livelihood in Northern Finland. (Numbers refer to districts in Table 1.)

Table 1. Reindeer ownership, Northern Finland

54 Reindeer Owners Associations (In 14 marking districts)	Number of Reindeer	
	Max. allowed	Total
UTSJOKI		
1. Paistunturi	7,500	6,869
2. Kaldoaivi	6,500	6,678
INARI		
3. Näätämö	4,000	1,488
4. Muddusjärvi	6,000	5,290
5. Vätsäri	4,500	2,715
6. Ivalo	5,000	1,646
7. Hammastunturi	5,500	3,790
8. Länsi-Inari	8,000	7,718
ENONTEKIÖ		
9. Näkkälä	9,000	7,800
10. Käsivarsi	12,000	3,664
ETELÄ-LAPPI		
11. Muonio	6,500	3,566
12. Kyrö	3,000	3,083
KITTILÄ		
13. Kuivasalmi	7,000	4,247
14. Alakylä	4,500	2,746
SODANKYLÄ		
15. Sattasniemi	4,000	2,875
16. Oraniemi	6,000	3,150
17. Syväjärvi	5,500	3,681
18. Pyhäjärvi	1,000	680
19. Lappi	9,000	8,434
KEMINKYLÄ		
20. Kemin-Sompio	12,000	10,400
21. Sallan pohjoinen	5,000	2,971
SALLA		
22. Salla	5,000	4,233
23. Hirvasniemi	3,000	1,997
RAUDANJOKI		
24. Kallio	5,000	2,659
25. Vanttaus	1,200	644
26. Poikajärvi	5,000	3,640
LÄNTINEN		
27. Lohijärvi	1,200	1,011
28. Palojärvi	5,000	3,385
29. Orajärvi	1,600	1,057
30. Kolari alanen	2,400	1,192
31. Jääskö	1,000	728

ITÄKEMIJOKI		
32. Narkaus	2,000	1,521
33. Niemelä	1,600	1,061
34. Timisjärvi	2,000	889
35. Tolva	1,400	1,371
36. Livo	1,500	1,119
37. Isosydänmaa	1,500	1,075
38. Mäntyjärvi	1,200	656
39. Kuukas	900	740
KUUSAMO		
40. Alakitka	1,600	1,277
41. Akanlahti	1,200	1,113
42. Hossa-Irni	3,000	2,001
43. Kuusamo	4,000	2,979
PUDASJÄRVI		
44. Jokijärvi	700	704
45. Taivalkoski	1,400	1,926
46. Pudasjärvi	2,200	2,172
47. Oijärvi	1,000	806
48. Livo	1,500	1,378
49. Pintamo	2,600	2,822
50. Kiiminki	700	606
51. Kollaja	1,000	732
52. Ikonen	400	348
KAINUU		
53. Näljänkä	1,200	645
54. Halla	2,000	1,041

more and more dependent in the future upon the effectiveness of regional policies and temporary programs arranged by the state, while the spending capacity of the population, even the primary income in some cases, will be determined in part by the principles invoked for the payment of social security benefits. Meanwhile the satisfying of local needs regarding essential services will be determined to a great extent by connections with the outside world and the obtainability of commodities manufactured elsewhere. Thus the people of Lapland have become dependent upon the national press, radio and television, and upon the same innovations as may be found anywhere in Europe. The diminution of local opportunities for obtaining a livelihood on account of changes in the ecology of the natural environment, and the changes which have taken place in the people themselves, have assumed the proportions of a major crisis. This has in turn led to a more profound emphasis on the identity of the minority group, demands for the reinstatement of traditional rights and an absolutely rigid stand toward any changes in the natural environment in many instances, although in other cases one finds resignation, economic and social apathy and acceptance of the role of an onlooker. A third alternative is to continue with the former way of life as far as the circumstances allow, and a fourth is to move to a more prosperous part of the country.

The different population groups in Lapland have experienced the changed relationship between man and nature in quite different ways. The people in the main population centres

of the area have adapted well to the new way of life regardless of ethnic background, since the regular work and income obtainable from industry or the service occupations provide a sound basis for life on the normal Finnish pattern. Similarly the Lapp population of the more remote country districts have managed fairly well in this transitional period, most of the people continuing to acquire their livelihood from the land in the form of reindeer herding (Fig. 8), hunting and fishing, since the very remoteness of their situation has helped to preserve both the natural resources themselves and also the traditional way of life based on them. It is in the areas outside the centres that it has proved most difficult to find work, and it is here that most of the communities requiring social assistance, those in which the innovations have changed both the people and their natural environment, are to be found (Siuruainen 1976).

A relationship between the local population and the natural resources available, as observed in Finnish Lapland, is also to be found in the other Nordic countries. In Swedish Lapland the population is concentrated in the regional centres, and in Norway the circumstances on the coast of the Arctic Ocean, the existence of fishing and sea traffic and the discoveries of oil in the North Sea have all served to revive economic circumstances in the extreme north. In Lapland however, no significant new opportunities have yet presented themselves for such an economic revival. The area is too barren to permit competitive agriculture, the extensive felling that has already taken place has reduced the scope of forestry for some time to come, and the widespread draining of the mires has reduced the opportunities for the exploitation of the wild berries. At the same time the harnessing of the rivers has cut down the catches of commercially valuable fish and made conditions more difficult for reindeer herding. The introduction of more advanced technology into the herding economy has also been detrimental, as have the changes in the natural vegetation of the grazing grounds. On the other hand an improved road network has enabled tourism to extend even to the most remote areas of hitherto unspoilt countryside for brief seasons in spring and summer. The changes which have been taking place in the ecology of the area (including the way of life of its people) require a complete re-evaluation of its development, preferably in the direction of a more long-term program based on "soft technology".

State Measures to Develop the Conditions of Life in Finnish Lapland

In spite of the regional differences in physical conditions, the state has taken very much the same attitude towards the development of the Lapland area as towards other parts of the country. Efforts have been made wherever possible to create a functional infrastructure on the model of the majority culture, to support the necessary services and to stimulate the provision of industrial employment by offering high subsidies. The utilization and renewal of the natural resources have normally been allowed for according to the same principles as applied elsewhere. During the period of vigorous settlement it was certainly the aim to develop Lapland into one of the agricultural and forestry regions of the country. As for its resources however, the area has often been looked on as containing timber, energy sources, berries and other fruits of the earth, and a forest landscape for recreational purposes, all of which are simply there for the taking. The above facts illustrate the consequences of this policy.

Efforts have also been made by the Finnish government to develop the life of the local inhabitants consciously along lines suited to their special circumstances. The first committee was set up to produce guidelines for developing the economic and social conditions of the Lapps at the beginning of this century (Committee Report 1905: 3) and another

committee was formed for the same purpose in 1952 as the problem had become more acute (Committee Report 1952: 12). A later Lapp committee, on a rather large scale, submitted its findings in 1973 (Committee Report 1973: 46). Some of the proposals made have led to concrete results. The Lapp minority has been allowed to elect a representative body with powers to advise the state authorities, and the initiatives of this body have led to a number of rather more felicitous measures for developing the region.

One measure aimed at improving the natural sources of livelihood in Lapland is the Reindeer Farm law passed in the late 1960's, allowing for more than 200 reindeer herding families to be supplied with modern housing by the state. Similarly the rights of the Skolt Lapps to set up new farms in their areas have been extended. The state has also supported reindeer herding by maintaining taxes on this form of economic activity at a low level and by financing such projects as the building of essential boundary fences.

The precise definition of the hunting seasons for the various game animals, the organization and subsidization of fish breeding and the restricting of the rights over wild berries to the local inhabitants in the northernmost areas are all measures which have helped to revive traditional sources of livelihood.

An overall plan for the exploitation of natural resources in Lapland has been constructed by the Regional Planning Board for the province, including a land-use plan drawn up with the needs of the local population in mind. This takes account of the productive capacity of the local land and the suitability of certain areas for particular land uses. The overall plan also defines nature conservation areas, land and water areas to be set aside for particular occupations, agricultural and forest areas, and residential, service, industrial and recreational areas. This plan has no legal force. However, actual regional planning has to be based on an improved master plan which also has the approval of the local representatives in the communes concerned.

A starting point for the constructive development of the traditional ways of life of the area has been sought in the revival of local cultural and linguistic forms. Reindeer herding is included in the subjects offered in vocational schools and courses in the area, as also are fishing and traditional handicrafts. In many schools the Lapp children can now receive instruction in their own language. Also, the Nordic countries together maintain a Lapp Research Institute at Kautokeino in Norway, the purpose of which is to carry out research applicable to the revival of economic and social life among the minority group.

The present state of development in Finnish Lapland is one in which the area is emerging from a period of uncontrolled change to one of a more enduring form of utilization of the natural resources available. An effort is being made to direct the benefits obtainable from these more positively towards the local inhabitants, and increased information is becoming available to enable human activity to be adapted in accordance with local conditions. The various interests involved in national affairs are now beginning to realize that if Lapland is to retain any viable population base, this will require a return to balanced exploitation of the natural resources of the area, under modern conditions, of course, but employing the methods of "soft technology".

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EXPLOITATION AND CONSERVATION OF LIVING RESOURCES IN THE NORWEGIAN ARCTIC

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Introduction

The Svalbard archipelago is only a minor part of the Arctic. These islands have, however, played a rather significant role in the history of man's exploitation of Arctic resources during the nearly 400 years since their discovery by Willem Barents in 1596.

In more than one way the history of Svalbard is identical with the history of exploitation, or more precisely, the overexploitation of natural resources on these islands. Only during the last 10-15 years have new attitudes and philosophies with regard to conservation and long-term management of the environment and natural resources been evident. During the same period, however, it is encouraging to note how these ideas have led to considerable positive change after such a long period of Man's destructive activities.

The purpose of this paper is twofold:
— to review the history of exploitation and conservation in Svalbard during the last 400 years.
— to consider the possible role of Svalbard in the future, based on past experiences and a growing appreciation for more prudent use of the Arctic and its living resources.

The background for this paper is a Norwegian book in preparation, entitled "Svalbard — Man in the Last Wilderness". It should furthermore be added that in this paper some attention is also paid to the surrounding marine ecosystem, the Barents Sea, of which the Svalbard archipelago is an integrated component. This is not of minor importance when we are considering the future, and considering where the main environmental problems in this part of the Arctic may be located tomorrow.

Svalbard and the Barents Sea: a Brief Description

Svalbard was one of the first parts of the high Arctic to attract Europeans' interest for systematic and ruthless exploitation of natural resources. This does not only reflect the general and rapidly growing need of resources in central Europe at the end of the 16th century; it also reflects the physical fact that the Svalbard archipelago was one of the most easily accessible parts of the high Arctic, due primarily to a northern branch of the Gulf Stream transporting enormous masses of relatively warm water northwards along the western coasts of Svalbard throughout the year. South and north of Svalbard, these warm water-masses mix with currents of cold polar waters, resulting in a number of upwelling areas. These areas are basic elements in the high biological productivity both in sea and on land in the Svalbard area.

Climate on these islands is predominantly of a coastal character. Temperature exceeds 0°C during May and until September, with an average summer air temperature about +5°C.

Placenames in Svalbard

Winter temperatures are normally between −8 and −16°C. Precipitation is low, averaging 200-400 mm per year (mostly falling as snow during the autumn period). In spite of the rather favourable climate, a significant part of the land mass of the biggest islands is covered by permanent ice and snow.

Of a total land area of 62,000 sq km only an estimated 8,300 sq km (about 13 per cent) has a more or less continuous vegetation cover. The rest consists more or less of barren areas or land under permanent snow and ice cover. In general, only the coastal regions are of any biological significance. Nearly the whole biological productivity of the terrestrial ecosystem is concentrated in these restricted areas. Furthermore, we could add another important observation, namely that nearly all human activities in Svalbard have also been located in the same areas. This reflects also the conflict between man and the living resources in Svalbard:

— first, both man and nearly all important living resources are concentrated in the same restricted areas;
— second, the main part of the human activity takes place during the summer, the biologically productive (and vulnerable) period.

The bird and mammal communities in Svalbard are characterized by high Arctic species. The total number of bird species recorded in Svalbard is 150. Of these, only 32 breed regularly. Terrestrial mammals are restricted to Arctic fox (*Alopex lagopus*), Svalbard reindeer (*Rangifer tarandus platyrhynchus*) and the polar bear (*Ursus maritimus*). Connected to the coastal waters are the ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), walrus (*Odobenus rosmarus*) and the beluga (*Delphinapterus leucas*).

The Svalbard archipelago is located in the northern part of the Barents Sea, a shallow, highly productive Arctic sea. After the Second World War, some of the richest Arctic fisheries were developed in these waters. In addition, the region posseses significant populations of ringed, bearded and harp seals, polar bears and some of the largest seabird colonies on the northern hemisphere (colonies located on the coasts of Northern Norway, Novaya Zemlya, Franz Josef Land and Svalbard).

Exploitation of Living Resources in Svalbard: a Historical Perspective

The earliest expeditions to Svalbard after its discovery in 1596 were organized to search for new natural resources of economic interest. Indeed, resources were found in such abundance as to encourage numerous European ships and thousands of men to sail northwards to this archipelago for more than 350 years. During the very first years after its discovery, the walrus population provided the main interest. Soon after, however, another and even more peculiar marine mammal became more interesting: the Greenland whale (*Balaena mysticetus*). Catching and processing techniques developed rapidly, and so did the whaling industry. The Netherlands alone sent about 300 ships northwards every year in the 1630's, and their whaling industry gave work to about 18,000 people.

In the period 1669-1778 the Netherlands sent out an estimated total of 14,167 ships and killed about 57,590 whales in the waters from Svalbard to Greenland. It is no wonder whaling did not last long around Svalbard! By the 1640's the whales were nearly exterminated in the fiords and the coastal waters of Svalbard, and the search for whales concentrated on offshore areas. At the same time, the Dutch Smeerenburg, "the blubber city", housing thousands of people in the 1620's was deserted, and coastal whaling had come to an end. The Greenland whale, the first and also the most important living resource

for economic exploitation had been effectively destroyed, probably for ever. So effective was the extermination that even in recent years records of the Greenland whale in Svalbard waters are extremely rare. From the period 1958-1980 there are only two sightings of this species from Svalbard waters, and a total of only nine in the vast area from East Greenland to the Barents Sea.

After this first whaling boom came a rather different, and in fact not very well documented, chapter in the exploitation history of Svalbard. In the period from 1715 to about 1820 Russian summer and winter expeditions dominated on Svalbard. They harvested a wide variety of living resources, including eider down, reindeer, walrus etc. Despite a lack of historical documentation, it appears that the Russian operations apparently shifted from one part of the archipelago to another, giving local populations of birds and mammals possibilities to recover.

From 1800-1820, the Russian exploitation period came to an end, but man's pressure on the living resources continued. From the 1820's an increasing number of summer expeditions were organized to Svalbard from towns in Northern Norway, and in the same period Norwegian wintering expeditions were also frequently organized, whose interest ranged over a wide spectrum:

— meat, eggs and down of eiders and geese;
— walrus, ringed seal and bearded seal;
— beluga whale;
— reindeer;
— arctic fox and polar bear.

During the 19th century the exploitation of the living resources of Svalbard increased significantly because:

— exploitation became a year round, permanent activity in nearly all possible parts of the archipelago;
— a wide range of living resources was utilized;
— operations quickly became more efficient by the introduction of steamships and modern rifles in the second part of the 1800's.

When Svalbard came under Norwegian jurisdiction in 1920, the overexploitation was apparent to everyone:

— the Greenland whale and walrus were gone;
— the numerous Svalbard reindeer were on the brink of extinction;
— the eider and the Brent goose were severely reduced.

From 1920 and for the next fifty years, the exploitation continued on polar bear, arctic fox and ringed and bearded seals. During the same period however, the need for conservation and a wiser use of the environment and the living resources of Svalbard became slowly accepted.

Svalbard's Jurisdictional Status

Compared to other Arctic territories, Svalbard's jurisdictional status has been rather peculiar. During most of man's presence in Svalbard, the archipelago was considered a "no man's land". Its status as a "no man's land" continued until 1920, when the Svalbard Treaty was signed in Paris by 14 nations; at present there are 39 parties to this treaty, according to which Norway has "the full and absolute sovereignty" over the archipelago. However, citizens of the contracting parties to the treaty shall have equal rights to fishing

and hunting in the area, and to carry out any kind of maritime, industrial, mining and commercial operation, subject to the observation of local laws and regulations. Another important and also farsighted element of this treaty is the second part of Article 2, stating that Norway has the responsibility "to enforce the necessary measures to ensure the preservation, and if necessary the restoration of fauna and flora within the named areas and their territorial waters." To sum up:

In relation to conservation and management of the environment and living resources in Svalbard, three elements are of fundamental importance:

— Svalbard is a part of Norway, according to the Svalbard Treaty;
— the parties to this treaty have equal rights to the utilization of natural resources, subject to local laws;
— according to the treaty, Norway has responsibility for the conservation of flora and fauna in Svalbard.

Conservation History

The modern ideas of conservation born in North America in the 1870's came fairly early to Scandinavia. Already in the 1880's the Swedish polar explorer Nordenskiøld became a strong spokesman for conservation. In 1909 the first national parks in Scandinavia were established, in Sweden.

In 1914 Arctic conservation was placed for the first time, on the agenda of the international Spitsbergen Conference in Oslo. At this conference a proposal was tabled by the Norwegian government to establish a protected conservation area in the northwestern corner of Spitsbergen (the biggest of the islands within the Svalbard archipelago). However, no formal decision was taken at this conference.

The next sign of a growing conservation interest in this part of the Arctic came in 1925, when the Svalbard reindeer were totally protected. The year after, the Norwegian Conservation Society presented a detailed and far reaching proposal for the protection of areas in Svalbard and for the conservation and restoration of plant and animal life. From 1926 until 1940, the start of the Second World War for Norway, the Conservation Society continued actively to promote the conservation idea in respect to Svalbard. In 1932 two plant reserves were established in Spitsbergen, covering a total of 2,415 sq km. Furthermore, in 1939, the polar bear was totally protected in its most important denning area, the remote island group Kong Karls Land.

After the war, little interest was paid to Arctic conservation in Norway for a number of years. At the end of the 1950's and the beginning of the 1960's, however, a number of scientific expeditions visited Svalbard. Some of the scientists participating in these expeditions once again raised the ideas of the 1930's to protect unique parts of the archipelago and to restore the bird and animal life which had been over-exploited and destroyed during most of the 20th century.

In the mid-1960's the Norwegian Polar Research Institute included biology as a new discipline in its activities. The biological program of the institute was focussed on conservation-related problems. In 1966 the first "Study of present problems related to conservation and wildlife management in Svalbard" was completed. With this study, conservation in Svalbard soon came into focus, and practical conservation work in Svalbard could begin in earnest, at last. To follow up the study of conservation needs in

Svalbard, an interministry task force was organized. This task force worked from 1967 until 1972, when the Ministry of Environment was organized. The first problem the task force addressed was formulation of regulations to ensure better protection of the polar bear.

Soon after, in 1968, work also started on a draft plan for the establishment of national parks and nature reserves in Svalbard. However, at that time other activities had also started in Svalbard: oil exploration more especially. During the 1960's and the beginning of the 1970's, a number of companies were involved in oil exploration in Svalbard, and large areas were gradually covered by oil claims. Once again conservation seemed to be the loser. 1971 became the most critical year: that year oil claims were issued to oil companies on Kong Karls Land, where the polar bear itself — but not its habitat — had been totally protected since 1939.

The same year oil claims were issued to oil companies on Edgeøya and Barentsøya at nearly the same time as the task force presented proposals for the establishment of nature reserves on the same islands. The conflict between economic interests and conservation was apparent to anyone. This confrontation had also serious legal and international aspects related to the interpretation of various articles in the Svalbard Treaty. Article 3 and 8 outlines the rights of citizens of the contracting parties to carry out commercial and economic operations. But the treaty (Article 2) also underlines Norway's responsibilities with regard to nature conservation. In conservationist circles questions were raised as to the meaning Article 2 could have if oil drilling was allowed at Kong Karls Land, the most important denning area of the polar bear.

In this rather delicate situation it is interesting and also encouraging to note that immediate action was taken: in May 1971 Kong Karls Land was formally established as a nature reserve. For the first time in Svalbard's history, a serious confrontation was won by the conservation side against the traditional interests involved in exploitation of Arctic resources.

The conflict in respect to Edgeøya and Barentsøya was resolved in another, rather peculiar, way when later in 1971 two sets of regulations were adopted:
— regulations to control technical activities in Svalbard to protect the environment;
— safety regulations for test drilling operations in Svalbard.
After the implementation of these regulations, oil drilling operations were allowed in the areas of the highest potential interest in Edgeøya and Barentsøya. The immediate damage to the environment had been avoided, since operations had to be organized according to very strict regulations. But what would the consequences be if oil was found? At this time, plans for the establishment of reserves and national parks in Svalbard were also completed. In 1972, shortly after the establishment of the Ministry of Environment discussions started.

The conflict was once again apparent: at the beginning of 1973 a total of 1,259 oil claims had been issued to various companies, and of these, 668 were located within areas of high ecological importance. To find a compromise under such circumstances was far from simple. The final solution was as follows. First, in areas with a high potential for petroleum reserves, and where conservation interests were not of the highest priority, plans for protected areas would not be considered until test drilling operations had been completed and a final decision could be taken. In practice, this category included large areas within the proposed conservation areas of Edgeøya and Barentsøya and Southern

Spitsbergen. Second, in areas with a more restricted potential for petroleum reserves, and high conservation value, the establishment of conservation areas would be given first priority. Third, areas of the highest conservation value should be protected even if the potential for petroleum reserves was high.

The immediate result was not very encouraging for the conservation side however, despite the policy recommendations, for of the 668 conflicting oil claims, permission to perform test drilling operations were given to 646 and full protection only to 22.

This was, however, not the whole story. The final results were more encouraging: after the test drilling operations had been conducted, all results were negative. As a consequence, a final decision was taken by the government on 1 June 1973 to establish 3 national parks, 2 large nature reserves and 15 bird sanctuaries in Svalbard.

Review of Present Conservation Status in Svalbard

In spite of the continuous destruction and overexploitation of the living resources in Svalbard for more than 350 years, few practical conservation measures were taken until the 1960's. In fact, nearly all important steps for conservation and management has been taken during the last 15 years. So far, the results of these measures are rather promising.

In Tables 1 and 2 summaries are given of protected areas in Svalbard and of the past (1930) and present (1980) status of some of the living resources. Status for protected areas has changed markedly. In the 1930's plant life was protected in two areas, and the polar bear was totally protected in its most important denning area (Kong Karls Land). However, these measures were not very farsighted. In fact they gave protection to the species but did not ensure legal protection of their habitats. Not before the establishment of national parks and reserves in 1973 was effective protection given to the most representative and ecologically important parts of the archipelago. The present conservation areas total about 30,000 sq km or 49-50 per cent of the total land area, and includes nearly all important ecological areas in Svalbard. In addition the protected areas also include the surrounding territorial waters.

Table 1. Summary of protected areas in Svalbard, 1980

Category	Name	Extent (sq km)
National Parks	Sør-Spitsbergen National Park	4,673
	Prins Karls Forland National Park	640
	Nordvest-Spitsbergen National Park	3,283
Strict nature reserves	Søraust Svalbard nature reserve	6,450
	Nordaust Svalbard nature reserve	15,550*
Bird sanctuaries	Sørkappøya, Dunøyane Isøyane, Olsholmen, Kapp Linne, Gåsøya, Bohemanøyane, Plankeholmane, Forlandsøyane, Hermansenøya, Lovenøyane, Blomstrandhamna, Guissezholmen, Moseøya, Skorpa.	Small islands of very restricted size

Note: *Status as Biosphere Reserve.

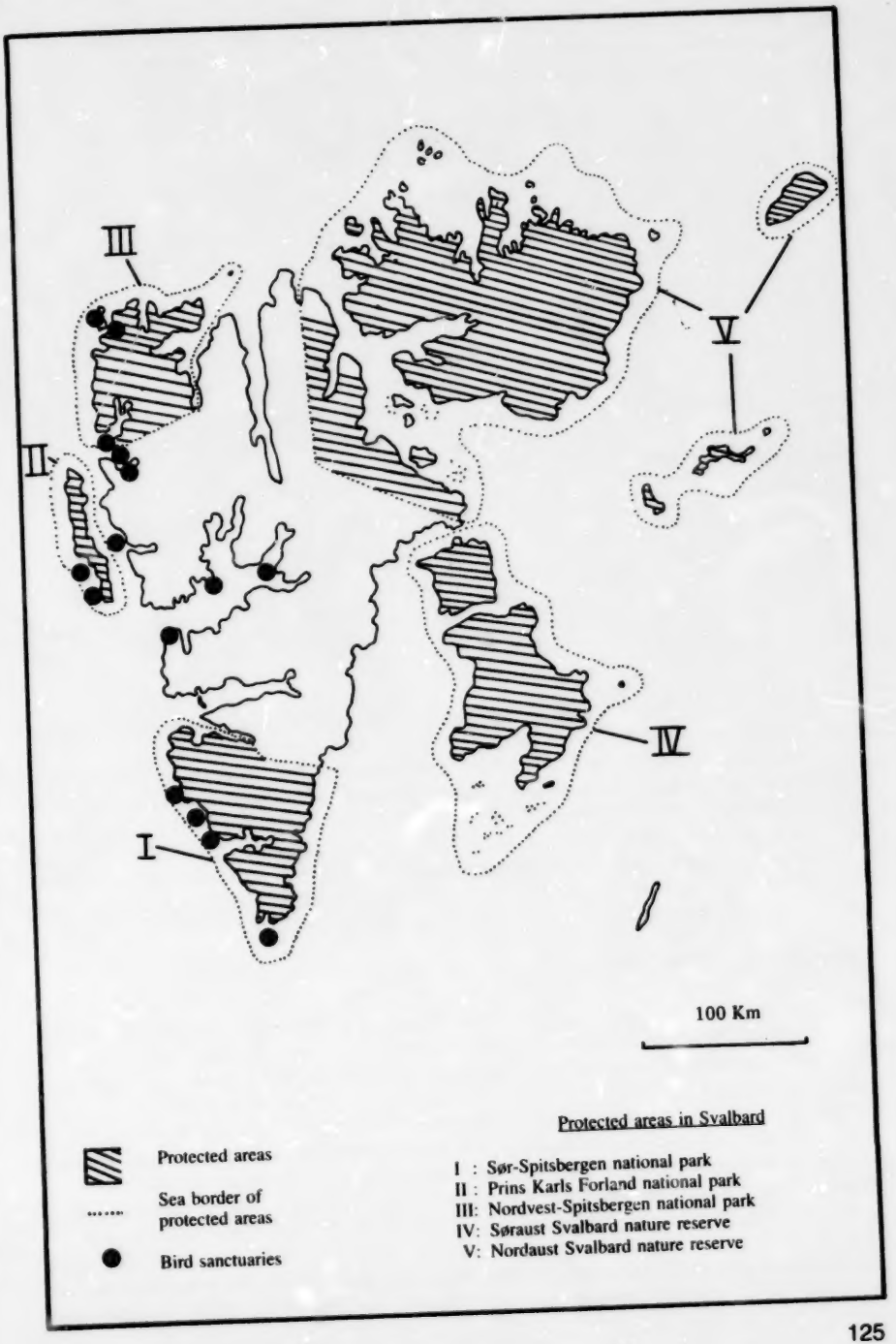
III
II
V
IV
I
100 Km
Protected areas in Svalbard
Protected areas
Sea border of protected areas
Bird sanctuaries
I : Sør-Spitsbergen national park
II : Prins Karls Forland national park
III: Nordvest-Spitsbergen national park
IV: Søraust Svalbard nature reserve
V: Nordaust Svalbard nature reserve

Table 2. Past and present status of some birds and mammals in Svalbard

Species	Status 1930		Status 1980	
	Conservation measures	Population trend	Conservation measures	Population trend
Greenland whale	None	Biologically extinct	Total protection	Biologically extinct*
Walrus	None	Decreasing	Total protection 1952	Increasing
Reindeer	Total protection 1925	Increasing	Total protection	Increasing/ stabilizing
Polar bear	None	Probably decreasing	Total protection 1972	Increasing
Eider	None	Decreasing	Total protection 1964	Slight increase
Pinkfooted goose	None	Unknown	Open season	Increase
Barnacle goose	None	Unknown	Total protection 1955	Increase
Brent goose	None	Decreasing	Total protection 1955	Stable

Note: *Two recorded observations in Svalbard waters 1958-1980.

A significant part of the land area within the protected areas is covered by permanent snow and ice. Sør-Spitsbergen national park consists of 65 per cent glaciers or areas under permanent snow/ice cover, and in Nordvest-Spitsbergen national park, the corresponding figure is 43 per cent. On the legislative side, considerable improvements have also been achieved during the 1970's, for example:

1971: provisional regulations to control interference with nature.
1974: regulations to protect cultural monuments in Svalbard.
1978: new game regulations giving in principle total protection to all birds and mammals, except when othewise stated.

Future Conservation Tasks

During the last 15 years the conservation process in Svalbard has been characterized by various efforts to reduce environmental destruction and to restore depleted populations of birds and mammals. During the decades ahead we may foresee a further development characterized by:

— further restoration of the living resources;
— management aimed toward maintenance of environmental quality and of populations of birds and mammals at their original level.

Furthermore, we may well foresee that attention will gradually change from terrestrial towards marine ecosystem problems.

In relation to terrestrial conservation, threats to populations from direct overexploitation may now be considered more or less a problem of the past. Even direct threats to the

terrestrial environment from technical interference could probably be considered as a minor problem in the future, because:

— most ecologically important parts of the archipelago are now located within protected areas;
— potential for terrestrial petroleum findings is apparently low;
— present coal mining is located within a restricted part of the archipelago (and outside the protected areas).

Apparently, the main terrestrial environmental problems in the future will arise from visitors seeking outdoor recreation, wilderness experience and research opportunities in this high Arctic environment. During the winter, these problems are related to recreation activities from people living in local communities, and their increasing use of motor toboggans (skidoos). During the summer, problems basically stem from two groups:

— tourists seeking various forms of wilderness experience;
— scientific expeditions conducting various research activities.

Problems related to increasing number of summer visitors were foreseen even before the Svalbard airport was opened in September 1975. At present, there are now regular flights between mainland Norway and Svalbard twice a week. In coming years the seriousness of environmental problems caused by the increasing number of visitors to Svalbard will depend on various management factors that will include, e.g.:

— regulatory measures within the protected areas;
— visitor facilities and information service outside protected areas;
— type and location of research facilities;
— developments in local transportation facilities.

In addition, much will depend on a strengthening of the local conservation unit and the need to develop a research and monitoring system to follow developmental effects in the protected areas and upon the flora and fauna.

The Barents Sea: a New Resource Frontier?

In the 1980's oil exploration activities will increase in the Barents Sea. In this connection coastal bases on Svalbard may be considered for offshore activities in the northern parts of the Barents Sea. The impact from possible coastal bases on the terrestrial and coastal environment will almost certainly be negative. In the next decades, however, the most serious problems to the environment and the living resources in this part of the Arctic will most probably appear within the Barents Sea. The main problems may, in principle, be of three kinds:

— overfishing of economic important fish-stocks; this problem is already appearent in a number of fish stocks of commercial interest in the North Atlantic, and
— ecosystem-related problems caused by traditional single-species management:
  — interference between fish stocks under intensive fishing pressure and an increasing population of harp seals (*Pagophilus groenlandicus*) recovering from earlier overharvesting. (Estimated population of harp seals whelping in the White Sea is at present (1980) about 970,000, compared to a former (estimated) population of 3 million).
  — possible negative impact on colonial seabirds from man's intensive capelin fishery in the Barents Sea. (So far no effective monitoring system has been established to study this problem).

Such complicated problems underline the need for a more advanced management regime for marine resources in the future, based on an ecosystem approach and multispecies management.

Apart from these strictly biological problems, there are technical problems related to future oil exploration activities in the Barents Sea. In 1980, test drilling operations started in the Barents Sea off the coast of northern Norway. These operations ceased during the winter months, but started again in April 1981.

Also in the Russian part of the Barents Sea oil exploration in being actively considered. These operations will most certainly also move into the biologically productive waters in the central and northern parts of the Barents Sea. With these expanding activities the risk for environmental problems will also increase. Among these problems are:

— risks of oil pollution in the drift ice areas;
— damage to marine organisms;
— increased mortality among millions of seabirds migrating across the Barents Sea during spring and autumn.

So far, our understanding of the Barents Sea ecosystem and of the ecological consequences of overexploitation and oil exploration must be considered as fragmentary.

With the expansion of oil activities in the North Sea in the 1970's in mind, there are reasons for concern with regard to activities in the Barents Sea in the 1980's. The Barents Sea is not another North Sea. It is a polar sea with drift ice, long periods of darkness, strong winds and very unpleasant temperatures. Today, however, we may only speculate whether or not oil reserves will be found and what environmental problems may arise in association with their exploitation. A few years from now we may well have the facts.

Perspectives in Arctic Conservation: a Future for the Wilderness?

In September 1972 some of us took part in IUCN's technical meeting in Banff to discuss Conservation for Development. Looking back, I think this was the beginning of an important process we have witnessed in the 1970's. That process has led to the gradual understanding, also outside ecologist's circles, that there can hardly be any economic development, in the true sense, if basic ecological principles are neglected. To many people however, "basic ecological principles" still remain only a nice phrase.

What are the basic ecological principles we should follow in the Arctic? A very constructive answer has recently been given in general terms by IUCN in the World Conservation Strategy of 1980, namely:

— to maintain essential ecological processes and life-supporting systems;
— to preserve genetic diversity;
— to ensure sustainable utilization of species and ecosystems.

These principles should now be stressed and repeated all over the world. In this connection it is encouraging to note that these principles are now reflected in the International Development Strategy for the Third United Nations Development Decade, and in UNEP's Medium Term Plan for 1982-83. More especially with respect to the Arctic, these principles can be reduced to one overriding goal, which can be stated as follows: to maintain the biological productivity and genetic diversity during the (shorter or longer) period when non-renewable resources are extracted from the Arctic. In this perspective, the conservation of wilderness as a dwindling resource should be regarded as a basic element in defining a future-oriented land-use policy for the Arctic.

Turning once again back to Svalbard, we may well forsee a future, after the coal resources are gone, when these islands are maintained as an "Arctic Galapagos" for conservation,

science and wilderness experiences. It should, in this connection be mentioned that Charles Elton, one of the founders of modern ecology, started his fieldwork in Svalbard as a young student in the 1920's. In other parts of the Arctic also, this may well be the best alternative, by adding the needs and interests of local people and the utilization of renewable Arctic resources on a sustainable basis.

In this audience, it is certainly not necessary to further elaborate this argument. We need however, more than ever before, to stress the qualities of what Aldo Leopold more than 30 years ago called "raw wilderness". In this field, North America has a long and leading tradition. You may recall, for example, H.D. Thoreau's philosphy behind his eight word message in 1851: "in wildness is the preservation of the world". Again, nearly a century later, Aldo Leopold's ecology-oriented wilderness philosophy in which he stressed the cultural importance of wilderness, because "all history consists of successive excursions from a single starting-point, to which man returns again and again to organize yet another search for a durable scale of values." And more recently, I recall Bob Weeden's strong plea at the conference on "Productivity and Conservation in Northern Circumpolar Lands" here in Canada in 1969, when he stressed that "the world needs to know that there is a place where man lives amidst a balanced interplay of the goods of technology and the fruits of Nature." What we need today is to formulate these basic thoughts into an action-oriented Arctic policy. If this were to occur, what then would be the challenge in Arctic conservation in the 1980's?

Answers will certainly differ from one country to another. However there are some general points of importance to all Arctic nations in the next decades:

- to develop national strategies for Arctic conservation, focussing on programs both
  - to ensure protection of representative and ecologically important parts of terrestrial as well as marine ecosystems; and
  - to restore endangered species and maintain genetic diversity.
- to develop more ecologically advanced management regimes for economically important living resources and their environment and to ensure sustainable utilization.
- to encourage ecological, conservation related, research to improve the scientific data-base for the two points above.
- to develop cooperation between the five circumpolar nations in the field of Arctic conservation.

With regard to international cooperation among the five Arctic nations, the cooperation initiated in 1965 to protect the polar bear as a resource of common interest has been most encouraging. The agreement was signed by the five nations in 1973, and earlier this year the five nations agreed to extend the agreement during their discussions held in Oslo. At the same time, however, it is less encouraging to see how difficult it has been to promote a wider international cooperation in Arctic conservation. Consider that during the polar bear conference hosted by the government of the United States in Alaska in 1965, the question was discussed among the five nations. This was followed in 1969, by another promising initiative, taken by Canada, in hosting the conference on "Productivity and Conservation in Northern Circumpolar Lands". Then during the United Nations' Conference on the Human Environment in 1972, Norway offered to host a conference on future cooperation in Arctic conservation. In fact, throughout the 1970's IUCN tried in vain, to establish an "Arctic Environment Specialist Group" with representatives from the five Arctic nations. Finally, during the polar bear research and management meeting in Oslo earlier this year, the Norwegian government once again proposed to initiate closer cooperation among the Arctic nations in the field of conservation of nature, flora and fauna.

In spite of these efforts, we may, however, conclude that during the last 15 years little has been achieved. However, notwithstanding these disappointing experiences, we must continue our efforts to find ways and means for active international cooperation in Arctic conservation, keeping in mind the positive achievements in the field of polar bear conservation.

Perhaps work could start with one or two conservation problems of interest to two or more of the Arctic nations. Experience could then be gained and cooperation further developed. Based upon the past, modern man's performance in the Arctic badly needs to be improved. This is a challenge in modern conservation. The future of the Arctic, its uniqueness and qualities will depend on the action taken by the Arctic nations in the 1980's. And in this respect, a 50-year old quotation of another of North America's emminent conservationists, Robert Marshall, is still valid: "There is just one hope of repulsing the tyrannical ambition of civilization to conquer every niche on the whole earth. That hope is the organization of spirited people who will fight for the freedom of the wilderness."

"LAND USE — NORTH" — RESEARCH ON LAND USE CONFLICTS IN NORTHERN SWEDEN

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A Summary Statement

This research project aims to clarify the interplay between different interests in the multi-purpose utilization of land in interior Norrland. The purpose of the study is to elucidate the land-use consequences of alternative courses of societal development and to clarify the consequences for society and different interests when selecting different land-use policies.

Four very important activities utilizing land in Norrland are forestry, reindeer-herding, tourism, and the development of hydro-electric power. From an ecological viewpoint they compete for the limited natural resource of land. A change in the intensity or direction of an activity brings about altered conditions for other activities. In addition to their dependence on natural resources as the fundamental prerequisite, these activities are also highly dependent on conditions in the surrounding world. The aim is to explain the present situation from the ecological, economic and social bases. To accomplish this, however, the historical development must be analysed in certain essential respects. From this point it is also intended to throw light upon possible future trends concerning land-use and the conflicts which they can generate.

In recent years there has been a debate in Sweden concerning the conflicts between forestry and reindeer herding. Forestry rationalization affects reindeer herding as regards the availability of grazing in the area where the reindeer happen to be, and also as regards access to different grazing areas. The acreage covered by reindeer herding is determined by migrations between the various mountain and forest pastures, the geographical position of which is a result of adjustment to climatic conditions and the practicalities of pasturage production. In addition to these natural constraints, reindeer herding is subject to statutory regulations, "the cultivation boundary" and "the reindeer pasturage boundary" being fundamental factors of this kind with a bearing on seasonal land use. Reindeer herding during the past half century has been distinguished primarily by fairly heavy fluctuations in the size of the reindeer population. Technological changes have also occurred, particularly in the transport sector, where motor toboggans and cars more especially, but aircraft too, have become important aids to herding operations. At the same time as land use has continued to involve extensive acreage and long migrations of herds in the traditional basic manner, the families of reindeer herders have been able to establish permanent homes with better access to social services. It is with reference to the above considerations that the utilization of the landscape for vegetable and animal production is to be investigated in the course of the research project.

The harnessing of the rivers of northern Sweden was virtually completed during the 1970's, but it has had a permanent impact on the landscape and land use, affecting several

activities. Only one effect will be considered here: the impact of hydropower development on reindeer herding. The Mountain Lapps and their herds migrate long distances between the summer pastures in mountain areas and the winter pastures in forest areas. The Forest Lapps migrate shorter distances but still cover considerable areas. A river and its valley can provide reindeer herding with a natural boundary, a migration route, grazing, a collecting area, calving country, hunting ground and fishing waters.

Thus reindeer herding has been adapted to utilize the natural conditions presented by the river valleys. This is why serious conflicts usually occur between hydropower interests and reindeer herders. The effects of interference with reindeer grazing are often hard to predict. Hydropower development can impede reindeer herding in many ways. Flooding can destroy reindeer pasturage, migration routes and technical facilities. It can also be an indirect cause of damage, for example by impairing the size and location of grazing areas, making them more difficult to utilize. There are also transitory difficulties occurring while construction is in progress and in connection with the adjustment of reindeer herding to the new conditions applying as a result of hydropower development.

The study of land-use conflicts in the interior of northern Sweden will also include the land requirements of mobile outdoor recreation and holiday homes.

In the mountain region particularly, the utilization of the leisure landscape tends to be divided into periods. A peak period for winter tourism occurs around Easter, and its summer counterpart, which is less intense, comes in July and August. During the spring months several thousand people enter by major roads in the main valleys to go fishing in the local lakes and skiing in the mountains.

The question is: do any conflicts arise concerning land use, and if so, where and why? There may be a definite conflict between reindeer herding interests and tourists. Reindeer herds remaining in the mountains during winter are liable to be disturbed by motor toboggan traffic, which also affects the even more sensitive calving lands later on in spring, where disturbances can have disastrous effects on the reproduction of a herd. During summer the herds often graze quite far up in the mountains and usually escape contact with tourists.

RENEWABLE RESOURCES OF NORTH-EAST SIBERIA

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A large territory known as North-East Siberia is, in fact, the greatest peninsula of Euro-Asia. About 80 per cent of this region is mountainous and only 590,000 sq km are classified as lowlands. Major river basins of the North-East drain into the Arctic Ocean (Yana, Indigirka, and Kolyma) and Pacific Ocean (Anadyr); the major rivers are deep and supplied mainly from rains.

All of the North-East territory lies in a zone of negative average annual temperatures (−3.2°C). Inland regions, and particularly lowlands areas have the lowest precipitation (up to 150-200 mm per year). The cold pole and the pole of continentality of the Subarctic Earth Belt are located here, at Verkhoyansk and Oimyakon respectively. The average temperature in January is about −50°C; there are many hot days in summer, but the stable warm period (exceeding 15°C) is only about 20 or 30 days duration. North-east of the Kolyma basin and Chaun Lowland the continental climate gives way to the maritime influence; on the Okhotsk and Bering sea coast the annual precipitation is about 500-600 mm. The whole North-East region, except the narrow Okhotsk and Koryak coastal zone in underlaid by permafrost, which is 400 m deep; soil depth during the summer thaw is to a depth of one or more metres in stone-sandy grounds, and 0.3-0.4 m in loams.

This brief descriptive background indicates that the North-East is characterized by an extremely unfavourable combination of natural conditions for biological production and agricultural development. In the present report I will attempt to describe in general terms the current status of soil and vegetation resources, hunting and husbandry, and also a number of biological problems. The solution of these problems is of great importance for developing appropriate branches of the regional economy.

Agriculture

Prior to considering the state of and prospects for agriculture in the North-East, somwhat unpromising characteristics of the regional soils as a base for agricultural production should be noted. Approximate calculations, indicate that mountain tundra soils and stone-lands occupy 75 per cent of the region. Arctic tundra and bog cryogenic soils, which are hardly used, make up 72 per cent of plain soils. Within the taiga zone, where climatic conditions allow for plants to grow in the open grounds, plain soils comprise eight per cent of all North-East soils. In 1980 arable land comprised 0.2 per cent of the territory. The most fertile areas are river-plain soddy and old river-plain soils with favourable physico-chemical properties. A considerable part of these soils can be used only selectively, e.g., as hay and pasture lands, because of their location in zones of water and fish protection. The overwhelming part of plain soils of the North-East are ferrous-humic-alluvial-podzolic soils, subarctic brown forest soils, frozen humic, tundra peaty gley and bog cryogenic soils. In their natural state these soils are hardly fertile as they are rather acid, cold and poor in nutrients; nevertheless, they will be used for further expansion of arable

lands. For successful agricultural exploitation of these soils both the technology of their development and agrotechnical methods are to be improved; such developments are already in progress.

At present there are some agricultural zones in the North-East. They are Central Stock and Vegetable Farm in Yakutsk, Stock and Potato Farm near Okhotsk, Chukotka Reindeer Breeding Farm, and others. However, we will not provide more detailed consideration to each of these zones in the present paper, though the main features of some agricultural activities throughout the region will be discussed below.

Crop Production

Despite difficult soil and climatic conditions in the North-East, crop production was, up to a point, successful. In 1980 in the Magadan region, the average potato crop was 15,000 kg per ha*, cabbages 17,000 kg per ha and annual silage grass 11,000 kg per ha. The leading farms produced 22,000 kg/ha of potatoes, 45,000 kg per ha of cabbages, and 25,000 kg per ha of grass. Nevertheless, the harvest of potatoes and vegetables only supplies 35 per cent and 20-25 per cent respectively of local needs. Next year it is planned to increase the supply of local potatoes and vegetables to meet 50 per cent and 35 per cent of requirements respectively. The output of winter and spring rye, ryegrass, swede, and perennial grasses are quite modest. The limited variety of crops available makes it difficult to use agricultural lands more rationally. Scientific trials show that when providing special "northern" agricultural techniques the number of crops can be increased to a significant extent. These techniques are as follows:

a) obligatory programmed use of large quantities of organic and mineral fertilizers;
b) fertilizers used with lime background;
c) fertilizers applied during the growing season because of the low retention (through leaching) of most northern soils;
d) obligatory anti-erosion measures should be provided. Vegetable production in greenhouse complexes heated by cheap thermo-sources is rather efficient in the North-East.

Reindeer Breeding

The leading branch of stock breeding in the North-East is reindeer farming which will likely remain the main meat provider and a primary field of employment for the aboriginal population. More than 40 per cent of the total reindeer livestock in the USSR, namely 1 million head is grazing in this region. Reindeer breeding produces 57 per cent of all local meat and a great amount of raw leather for local industrial and domestic requirements. In comparison with other kinds of meat, venison has the lowest cost. However, the prospects for further development of reindeer farming in the North-East now seem limited, due to a number of circumstances. In the first place, further increase of reindeer numbers will lead to overgrazing of the lichens, as was the case at the end of the nineteen sixties. Second, the lack of reindeer breeders is becoming an acute problem. The fact is that the young native people don't want to devote themselves to traditional employment, which seems to be a regular consequence of social and economic progress. The marked reduction in reindeer breeders has caused a tendency for herd amalgamation to occur. Grazing of

*Editor's Note: The author expressed these quantities in centners per hectare; these yields have been converted to kilograms/hectare (1 centner = 100 kg).

over-sized herds has interfered with herding practices, resulting in trampling damage to the pasture lands.

These problems will soon require new methods and forms of reindeer farming, for example, the use of hedges, close-herding, and so on, which will require considerable investments, organizing efforts and scientific attention given to a number of problems. It should be remembered that reindeer breeding is, in fact, an extensive sector of the economy which in practice will exclude the means of intensification available in other fields of stock breeding. Therefore, as mentioned above, an increase in reindeer production is not, evidently, to be expected in the near future.

Cattle Breeding

Significant advances are being achieved in cattle breeding which is mainly aimed at supplying people with milk, and only secondarily with meat. In the Magadan region, for example, during the last decade livestock numbers were doubled and milk yield increased by 64 per cent. Milk production averaged 3,500 kg per milch cow in 1980. It is planned to provide the population with 96 per cent of milk requirements in the future.

The current and prospective state of milch cattle husbandry in the North-East, and in particular various zootechnical and breeding programs, shows that the planned increase in production is practicable. However, the problem of fodder supply still remains unsolved. Increasing the yield capacity of grasses for producing hay and silage is not a problem, it can be reached by agrotechnical measures. It is much more difficult, however, to improve natural haylands and grasslands and to make additional, artificial, haylands. An active scientific trial is presently carried out on different perennial grasses and their acclimatization, using, for the most part native species, for example, *Beckmania syzigachne*, *Digraphis arundinacea*, *Alopecurus pratensis* and *A. ventricosus*, *Arctophila fulva* and others. Under conditions prevailing in Chukotka the use of artificially drained thermokarst lake beds holds much promise for making haylands. When sowing *Arctagrostis latifolia* with the natural grass stands, hay harvest comprises 5,400 kg per ha or 30,000 kg per ha of grass mass. Preventive measures need to be taken against the development of frozen forms of microrelief and waterbogging of these artificial grasslands. After 20-30 successive years of exploitation in this manner, it is proposed that the earlier-drained lakes be flooded again, for three or four years, to restore the sub-lake talik.

Poultry Farming

Last years poultry farming was subject to intensification, becoming a large specialized branch of agriculture. At present egg production supplies the needs of the population in full.

Forest Resources

Forest of the North-East make up 24.3 per cent of the total forest zone of the USSR. However, because of the great importance of *Pinus pumila* shrubland (constituting the most valuable hunting lands) they are also included in this zone. *Pinus pumila* moreover provides wood for handicrafts and seeds for food. Larch (*Larix duhurica*) is the dominant species in the North-East forests, comprising 80 per cent of total timber reserves, but throughout the territory they are distributed in an extremely uneven way. The main resources of industrial wood are centered in Yakutia. Forests of the Magadan region supply

nearly one-half of all local timber requirements. However, at the present rate of exploitation, the industrial timber resources in the Magadan region will be exhausted in 20-25 years. It is to be noted that larch trees reach marketable size at an age of 120-150 years, and it takes much time for their reproduction. Yakutia forests should, therefore, be reserved for North-East Siberian use only; it should be remembered that apart from their industrial value, forests play an most important role in nature protection.

Hunting Trade

Hunting lands of the North-East have average productivity. Arctic fox pelts comprise 50-60 per cent of total value obtained from sale of furs. Sable is the next most valuable fur with up to 30 per cent of the total; in some regions there has been observed an increase in total numbers of sable due to acclimatization measures taken earlier. The squirrel, with 10-15 per cent of total fur sales has been reduced in proportion to the increase in sable. Ermine, coloured fox, mink and muskrat make up 10 per cent of the total fur output.

It should be mentioned that about 40 per cent of hunting lands in North-East Siberia remains undeveloped, and there is real potential for considerable increase (up to 50 per cent) in the fur trade and other products of hunting. However, a lack of hunters makes it difficult to achieve this potential; it appears that not only other regions of the USSR, but also most countries with a "traditional" fur trade also suffer similar problems. It seems that the rigours of the work on the one hand, and the seasonal character of the work on the other hand cause reduced numbers of professional hunters, a reduction that the so-called "hunter-dilettantes" don't satisfactorily compensate for.

Several ungulate species should also be mentioned here. Elk (*Alces alces* L.) is widely distributed in North-East Siberia. Its population numbers 30,000 and it is hunted at the present time. In Euro-Asia, elk is incomparable with regard to the size of its antlers and body weight, making it an extremely valuable animal to hunters.

The population of wild reindeer (*Rangifer tarandus* L.), dwelling in the North-East of the USSR, number 20,000 head. During the 19th and 20th centuries their numbers became sharply reduced due to intensification of fire-arms hunting and grassland overgrazing by the increasing numbers of domestic reindeer.

Snow sheep (*Ovis nivicola* Esch) is native to the North-East; the best estimate of population is about 40-50,000 but it is decreasing at this time. With the creation of reserve areas, measures are being taken for the protection of these wild ungulates.

In 1975 20 musk-ox from Nunivak Island (West Alaska) were introduced to Wrangel Island; their acclimatization and adaptation to local conditions appears successful. In the first year four animals died from pneumonia. However, since then there have been seven musk-ox calves born on Wrangel Island.

Among birds, two species of grouse, namely, the white and tundra grouse are to be mentioned. Although cyclic fluctuations are observed in their numbers, under certain conditions these birds can nevertheless, be part of the hunting economy. Among waterfowl species, the white-fronted goose (*Anser albifrons*), and some ducks (e.g., *Anas penelope* and *Anas acuta*) and some others are numerous. These species continue to be hunted even though, during the last few decades their numbers have decreased.

Fisheries

North-East Siberia has great fish resources; however, stocks of some species have been seriously depleted, sometimes on account of overfishing by foreign fleets. Such practices led, for example, to the complete prohibition of herring fishing in the Okhotsk Sea.

In 1975, as a result of intensive fishing by Japan, the catch of salmon was reduced to one-third the 1947-1950 level. At present, due to measures regulating the sea fishery, an increase in the numbers of salmon migrating to the spawning areas is observed. The salmon catch has recently increased by 50 per cent; this tendency will continue, and during the 1985-1990 period production is expected to reach the level of the late 1940's once again. Using fish culture methods the salmon catch in rivers of the North-East can be considerably increased, up to 25-30 million kg annually. To achieve this level of production, however, it will be necessary to build a number of fish-breeding farms.

Fish ponds represent a rich reserves for fish-breeding. Potential fish resources produced inland for marketing total about 2.5-3 million kg. However, such methods are not used to the full; one of the main limitations to further fishery development is the great transport expenses when supplying consumers with fish.

Unfortunately this brief report cannot provide full information on the biological resources of North-East Siberia. In closing, I would emphasize the fact that this region has, although not extensive, rather intensive agriculture which holds great promise for further development. It is to be noted that this development will require considerable investments for further exploitation and improvement of new areas, and a number of problems are still to be addressed. Natural biological resources are of sufficient potential, but the experience in both forestry and the sea fishery have shown that development must be based on scientific findings with due regard to biological recruitment and productivity factors.

BIOLOGICAL AND MEDICAL INVESTIGATIONS IN THE SOVIET SUBARCTIC: Some Social and Economic Aspects

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Introduction

During the last two decades subarctic areas have been developing at a growing pace, primarily in connection with the exploitation of rich local deposits of raw materials for mining and energy industries. In the USSR this assumes great significance as far as the Far North is concerned, for climatically similar regions make up about 50 per cent of the whole territory of the country.

The intensive economic development of subarctic areas is followed by great movements of population, so that, for example, during the last 20 years the population has almost doubled in the North-East of the USSR. Due to the growth of population and associated anthropogenic influences upon the northern environment, biologists and physicians are now being confronted with new problems that require thorough study. The specific characteristics of Far Northern natural conditions preclude simple transfer of knowledge gained from the carefully investigated central regions.

Research Areas: Health, Food and Conservation

There can be distinguished three main groups of problems associated with northern development. The first touches upon particularities of man's adaptation in the North: for example, the study of specific morbidity patterns and preventive programs. In regard to such preventive measures research is envisaged to determine scientifically grounded genetic and psycho-physiological criteria for selecting people to settle in the North. At present, such selection occurs spontaneously due to high out-migration rates among new-comers to the North and leads to great unproductive expenses.

The second group of problems is associated with the provision of a local food base. High transportation costs, considerable losses in food and deterioration of its quality during transportation make it unreasonable to supply newly developed areas with all required provisions from the central regions. A great deal of experience with Soviet northern agriculture shows that 40-60 per cent of milk, meat, potatoes and other vegetables can be supplied by local resources. This question will have more detailed consideration in the report of Dr. Bogdanov.

The third complex of problems concerns environmental protection. The development of northern territories is highly localized and now affects only about 0.5 per cent of the total area. Preliminary data suggest this will increase to one per cent of the area by the year 2000. The local character of development raises serious problems of environmental protection near to settlements and industrial sites. The major part of the North is used for husbandry, hunting, fisheries and recreational activities. However, because of unstable and low self-restoring properties of northern biocenoses these economic activities can also cause environmental disturbance and must be regulated by strict rules for ensuring nature protection.

Institutional Resources in the Far North

Biological and medical problems connected with northern development are studied in many research institutions of the Soviet Union. During the last two decades the number of research institutes has been increasing. The main scientific centres are in Moscow, Leningrad and Novosibirsk. Moreover, in the North there were established a number of Biological Institutes of the Academy of Sciences of the USSR, namely the Kola Arctic Botanical Gardens, the Karelian Biological Institute in Petrozavodsk, and Komi Biological Institute in Sycktyvkar, the Yakutsk Biological Institute and the Institute of Biological Problems of the North in Magadan. These institutes have field stations in the most representative climatic zones, and the best known are stations of the Far-North Laboratory of the Leningrad Botanical Institute (Taray, Ary-Mas) and the Institute of Biological Problems of the North in Chaun Bay and Kolyma midcurrent. Incidently, at the latter two, American scientists have for some years been working on problems associated with the

protection of northern ecosystems under the Soviet-American Scientific Exchange Program.

Besides institutes of the Academy of Sciences there are a number of zonal institutes of agriculture. The most popular programs are at the Norilsk Institute of the Far-North Agriculture where acclimatization of musk-oxen sent to the Soviet Union by the Canadian Government is being studied.

Over the years teams of Soviet biologists have studied soils, plants and fauna, making soil maps, extensive herbarium and faunal collections. The results have been summarized in a number of monographs, where the "Flora of the Arctic" series is especially noteworthy. Now mainly completed, these studies are being followed at the present time by others on some insufficiently studied fields of biology, in particular involving invertebrates, soil microflora and hydrobiology.

Ecological Research

Under the auspices of the International Biological Program much attention was given to research on northern ecosystems. The results of this research considerably enlarged our understanding of the potentials of northern ecosystems, and altered widespread views on the supposed abundance of northern biological resources. This work was brought together in a series of publications dealing with the productivity, structure and function of tundra ecosystems. Further investigation of these problems, including the consequences of anthropogenic influences, is now being undertaken.

At the present time, Soviet biological research on northern ecosystems is characterized by ecological and eco-physiological studies, and combines traditional research methods with biochemical, electron-microscopic and other modern procedures. Profound work is being carried out in the fields of population ecology and genetics.

A study of the mechanisms regulating periodical population changes among lemmings of Wrangel Island is an example of these investigations. In this work endocrinologists, working alongside mammalogists, studied hormonal levels and the morpho-physiology of the neuroendocrine system. Parallel with confirmation of Christian's data on the role of the adrenal gland in population regulation, it was established that the main changes in endocrine status are due to the neuro-secretory hypothalamic system and the adenohypophysis. It appears that reproductive suppression occurs when the population peaks, as a result of insufficient hypophyseal gonadotropic hormone production caused by hyperfunction of the thyroid and adrenal glands. It has been found that maternal hormonal background levels exert an important in utero influence upon the development of the endocrine system of the succeeding generation. This effectively reduces the reproductive potential of the next generation leading to further depression of population numbers.

Great attention has been given to animal adaptation for subarctic conditions; along with morphological and behavioural mechanisms of thermoregulatory adaptation, bioenergetics are also studied. Soviet biologists are continuing the investigations started by American researchers, but directly in the field. The results of such long-term research, for example, are summarized in the monograph by A.V. Andreyev entitled "Birds' Adapatation for Subarctic Winter Conditions".

Development and Conservation

A wide range of investigations are being carried out as part of the Man in the Biosphere Program, coordinated by Soviet National Committee. One aim is to identify rare species, their distribution and ecological characteristics and to work out suitable protective measures. The status of hunting animals' populations is subject to strict regulation. Measures are being taken to establish a set of ecological reserves in the Soviet subarctic starting with the Asian regions. In the near future reserves in the subarctic are planned to reach the All-Union level. The question of reserves in the boreal forest zone all across the Soviet North is under discussion.

International collaboration in the field of environmental protection is quite effective. A striking example is provided by protective measures taken to preserve the snow goose colonies on Wrangel Island which are unique in Asia. Using plastic collars and feather colouring, Soviet and American specialists have established the particularities of snow goose migration routes and wintering grounds, which appear to be different from those of American and Canadian geese. This research has allowed limitations to be placed on the hunting of Wrangel snow geese on the American continent. These measures, together with arrangements developed by Soviet scientists for goose protection during the breeding season has considerably changed the status of this population, so that the rise in their numbers observed last year has reversed the reduction occurring earlier.

We can report that the experiment on musk-ox introduction is a success. Recently 20 musk-oxen were brought from Canada and 40 from Alaska. All the Canadian animals, and half of the Alaskan animals were settled in the Taimyr Peninsula where they lived in open-air enclosures, the remaining 20 animals were released on Wrangel Island. In the first year and a half some animals perished, mainly from bronchopneumonia. Mortality over the next period was not observed. However, both groups have been successfully breeding for the last two years.

Long-term research projects related to industrial development of the North are being undertaken. The Institute of Biological Problems of the North is studying ecological consequences associated with construction of large hydrotechnical works in the Far North. The first stage of this work has been completed: over a five-year period in the region of the Kolyma hydroelectric power station there were studies on the pre-construction aquatic ecosystems as well as the main terrestrial ecosystems extending from flood-land to the mountain tundras. In 1981 the second phase of research began, during which time changes associated with the lake reservoir formation will be observed. When the post-flooding hydrobiological regime of the lake reservoir is stabilized, the third stage of work will be started. This work is planned to extend over 20 years; its purpose is to develop measures for environmental protection in connection with building lake reservoirs in the permafrost zone. The presence of abundant local resources for hydroenergetic development makes this task practicable.

Medical Research: Physiological Problems

Medical problems associated with northern development were first studied by the Moscow Institute of Man's Morphology of the Academy of Medical Sciences of the USSR, directed by A.P. Avtsin, well-known specialist in geographical pathology. At present this Institute is occupied with research in the European North of the USSR and has its department in Arkhangelsk. A large scientific centre — the Siberian Branch of the Academy of Medical

Sciences, has been recently organized. This centre carries out studies concerning the North of Asian and the Far East.

Due to the extreme northern conditions new-comers to the region are subjected to a number of factors among which are low temperatures frequently combined with high humidity and strong winds, considerable falling and rising of atmospheric pressure, fluctuations of partial oxygen pressure, and specific photoperiodical regime leading to stress of circadian rhythms of physiological functions. Geomagnetic field oscillations, connected with solar activity, are also to be included here. Though the mechanism of their influence on man has not been elucidated, it has been observed that changes of the geomagnetic field, as first shown by the well-known Soviet biologist A.L. Chizhevsky, correlates with infectious diseases, cardiovascular problems, and neuropsychic activity.

Due to the above-mentioned factors, several major physiological systems suffer functional changes, whose cyclic characteristics may relate to seasonal changes in northern living conditions. These changes, being classified as adaptive, often become pathologic and lead to adaptation diseases; the most commonly observed in the North are associated with the respiratory, cardiovascular, immune, neuroendocrine and psychic systems.

Diminished partial pressure of oxygen and breath-holding at low temperatures (to limit heat loss) lead to the "polar short wind" and dysfunction of lung muscles. These factors cause changes in parenchyma and lung vessels and, thus, a rise in gas exchange and hypoxia compensation. These changes are described by Avtsin et al as "Magadan pneumopatic" and are followed by hypertension of pulmonary circulation. A high rate of respiratory diseases is the result of lowered organism resistance caused by changes in the immune system.

Changes in the cardiovascular system are also mainly related to hypoxia compensation. At first stages of adapation (first three years), changes become evident in the intensive cardioactivity, increased volume of circulating blood, high rate of blood flow, and rises in both arterial pressure and hemoglobin content. As the length of residence increases, there takes place a reduction in systolic activity with moderate hypertension. After 10-12 years, affected persons have a stable arterial hypertension frequently complicated by acute myocardial ischemia. Atherosclerosis very often develops in young age-groups due to elevated levels of lipoids and cholesterin in the blood, a result of metabolic shifts from carbohydrate to adipose synthesis.

Clear deviations were found when studying the neuroendocrine system, the most typical being an increased function of the sympathoadrenal system and adrenocortical tissue. The longer the term of livng in the North, the greater is the level of blood corticosteroids. After ten years of northern residence this level reduces, indicating decompensation of adrenocortical tissue function has occurred. Aldosteron level has similar dynamics. According to Berezin and associates, the function of the thyroid gland, on the contrary, is depressed.

Pathology development in the North is essentially influenced by changes in the immune system, expressed in insufficient T-system of immunity and autosensibilization followed by aggravation of chronic local infections and autoimmune pathology.

Psychological Stress Problems

During first 1.5-2 years of northern residence, changes in the psycho-emotional sphere are

observed; more especially increases in the alarm level and emotional stress was marked. Spontaneously vanishing, in some cases this factor leads to neuropathic and psychopathic states. The risk of psychic adaptation dysfunction develops even after ten years residence in the North.

The complex of functional changes in organs and systems connected with northern adaptation is described as "syndrome of arctic strain" in the Soviet literature (Kaxnacheyev 1980). Regularities in incidence of the syndrome's main parameters show three stages of man's adaptation in the north: first, a period of primary adaptation within the first three years of residence; second, a period of relative stability over the next 10-12 years; and last, the emaciation period or "northern tiredness." Adaptational failure in the first and third periods may result in pathologic consequences.

Soviet Approaches to Preventive Health Care

The elucidation of particularities of the adaptive changes occurring among northern residents allows health services to detect functional deviation before the onset of pathologic conditions. The main priority is to prevent diseases rather than to treat them. Periodical medical examinations of people are carried out in all large northern enterprises, with the aim of attending to the needs of the total northern population. This routine medical attendance reveals people highly predisposed for disease and allows their registration for ongoing medical control procedures.

Another strategy under consideration is the rational selection of suitable people for permanent residence in the North. Studies have shown that the aboriginal population has no adverse effects connected with the natural conditions of the North. In particular, there was not observed any rise in arterial pressure, activation of sympathoadrenal and adrenocortical systems. Lipemia, endogenic hypovitaminosis, and so on, caused by their phylogenetic adaptation to northern conditions. The works done in the Institute of Biological Problems of the North showed definite genotypical differences among aboriginal and recent immigrant populations. It was found, for example, that Chukchi have an unusually high frequency of A gene of acid phosphatase of erythrocyte, and Pp_2 variant of alkaline phosphatase. With long term settlement of immigrants in the North, however, the gene distribution showed a tendency to shift toward that of the aboriginal population. This phenomenon is a consequence of people selection caused by out-migration of that part of the immigrant population which could not adapt to northern conditions for prolonged time. There are many people who have been living in the North and have preserved good health and the ability to work to an old age. That is why in future we are not to place priority attention on the adaptive abilities of separate individuals, nor to fight against adaptation diseases, but rather we will endeavour to select people with definite geno-and phenotype showing preadaptation to northern conditions. This, however, must be preceded by long-term and thorough investigations in the field of medical genetics.

Naturally, in such a brief report it is impossible to give a complete consideration to biological and medical research related to northern development. However, we have tried to demonstrate here some examples of our main research orientations having social and economic importance in developing the Soviet subarctic regions.

FISHERIES OF THE JAMES BAY AREA AND NORTHERN QUEBEC: A Case Study in Resource Management

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Introduction

Since the signing of the James Bay and Northern Quebec Agreement, a number of fish and game background reports have been prepared, addressing the issues of biological potential of various kinds of resources, their harvesting levels, allocation of the permissible levels of harvest among the various user-groups, revision of existing regulations to ensure the conservation of the resource, and the general implementation of the Agreement.[1]

A broad survey of the living resources available in the James Bay area (Table 1) indicates that of the various groups of animals, fish probably have the greatest productive potential. Two of the major animal groups favoured by both native and non-native hunters, namely big game and waterfowl, have little potential for providing additional harvests. Fur animals probably have some additional potential, but the resource is limited by the extensive flooding associated with the hydro project. Small game such as snowshoe hares and ptarmigan have good potential only during the peak years of their eight to 10 year population cycles. Marine mammals support a very limited harvest in only two of the eight Cree communities.

This summary of the resource base applies only to the James Bay area (defined here as the area traditionally hunted by the Cree), and not to the Northern Quebec area (Hudson and Ungava bays drainage basins), most of which is traditionally hunted by the Inuit. In the latter area, the resource base is considerably different and the subsistence economy is based to a greater extent upon marine resources. Figure 1 shows the area and the locations of the Cree communities, total population about 7,000. One of these, Poste de la Baleine (Great Whale), is on Hudson Bay and is a mixed Cree-Inuit community. Fort George has a small Inuit population. The Naskapi community is near Schefferville. All the rest are Inuit communities with a total population of about 5,000.

This paper will focus on fishery resources of the James Bay area although some of the analysis will be extended to Northern Quebec. This focus is chosen in part because fisheries are relatively important in the subsistence economy and show additional development potential, and in part because a fairly large body of background information now

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[1]James Bay and Northern Quebec Agreement (Éditeur officiel du Québec, Quebec City, 1976) involves the Quebec Cree Indians and Inuit (Eskimo). The Northeastern Quebec Agreement involves the Naskapi. Wildlife management provisions of both of these agreements are dealt by a joint body of government and native representatives, called "Hunting, Fishing and Trapping Coordinating Committee", which has advisory capacity and can make recommendations directly to the appropriate federal or provincial minister.

permits some generalizations of fisheries ecology, estimates of potential and actual yields, and an overview of management and allocation issues, some of which may have implications for other parts of the North.

Table 1. Major subsistence food resources (according to the Native Harvesting Research Study, 1974-79) and their management status in the James Bay area.

Groups of animals	Important species	Potential for increased harvests	Allocation problem	Reference
Big game	moose	no; steady harvest despite increased effort	yes	Mallory (1979)
	caribou	no	yes	Mallory (1980)
Waterfowl	Canada geese	no; steady or declining harvests despite increased effort	yes	Berkes (1978)
	lesser snow geese	no; same as Canada geese	yes	Berkes (1978)
Fur animals	beaver	some potential in remote areas	no	Berkes, field notes
Small game	various species	yes, but only in peak years	no	Berkes, field notes
Marine mammals	ringed seals	yes, but limited populations	no	Berkes, field notes
Fish	whitefish	yes	no	Berkes (1980)
	predatory species	yes, but mercury problem	yes	Berkes (1980)

Characteristics of the Harvested Fish Populations

There are 32 species of freshwater fish occurring in the James Bay area (Magnin 1977a) of which the Cree utilize 15 (11 being important). The others are either rare or too small to be caught by the harvesting methods used by the Cree. According to an extensive sampling survey carried out in 1976 with four-inch mesh gillnets, which are the kind used by the Cree in lakes, the fish fauna consists of almost equal numbers of walleye, whitefish and white suckers, with eight other species making up th rest of the catch (Penn 1978). On the James Bay coast at Fort George and Eastmain, four sea-run fish (whitefish, cisco, brook trout and longnose sucker) comprise over 90 per cent of the catches. The composition of the harvest differs significantly from the composition of biological survey samples. For an analysis of selectivity of Cree fishermen, see Berkes (1979).

In contrast with the Inuit, the Cree are not a maritime people. They utilize sea-run fish but not marine species. In any case, the exploitable species consist mainly of sea-run stocks, together with only two fully marine species, Greenland cod and capelin. Biological productivity of marine waters of James and Hudson bays is relatively low, as known since the 1930's, due to low nutrient levels in surface waters (Dunbar 1970). Further, the food-web structure is such that there is relatively more marine mammal production than fish production.

Subsistence fishermen are selective also with regard to the size of the fish taken. Four-inch mesh gillnets used by the inland Cree select fish over a relatively small size range.

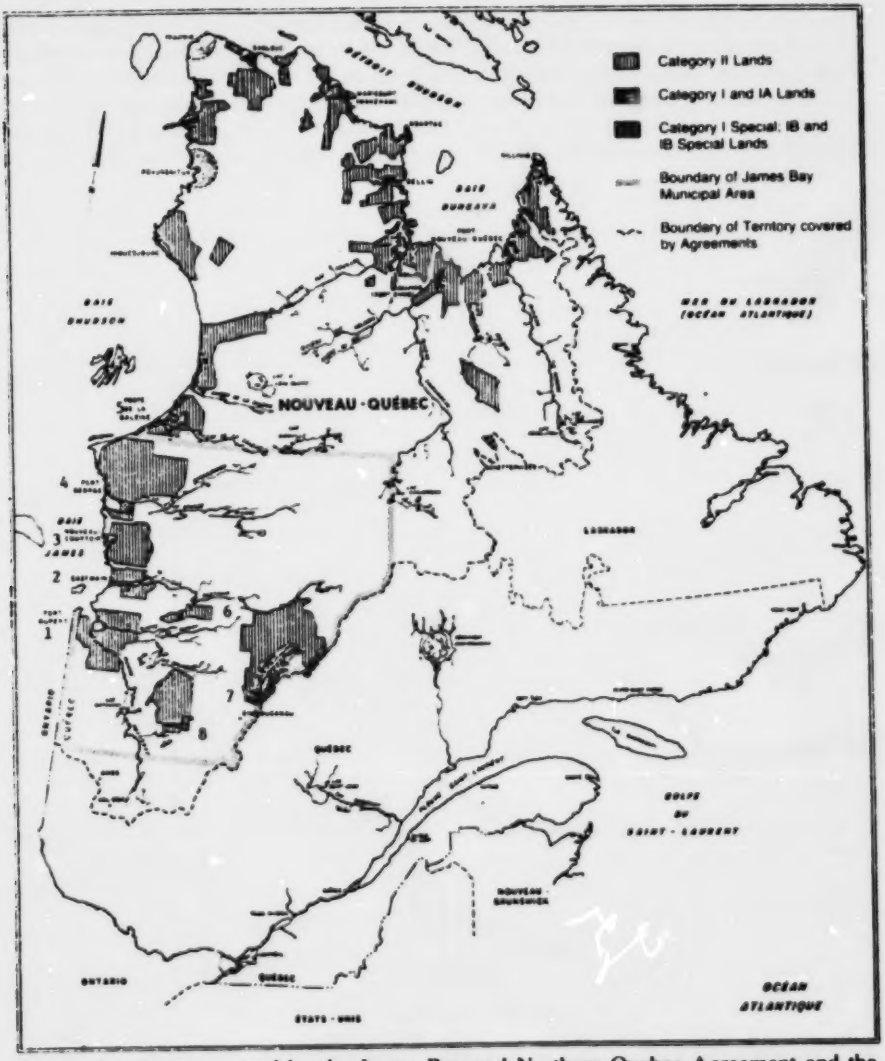

Figure 1. Areas covered by the James Bay and Northern Quebec Agreement and the Northeastern Quebec Agreement. Cree communities are numbered as follows: (1) Fort Rupert (Rupert House), (2) Eastmain, (3) Wemindji (Nouveau-Comptoir, (4) Chisasibi (Fort George), (5) Poste-de-la-Baleine (Great Whale), (6) Nemiscau (Nemaska), (7) Mistassini, and (8) Waswanipi.

According to Penn's (1978) data, the modal sizes in 1976 were about 50-55 cm (fork length) for lake trout, 40-50 cm for walleye, 40-50 cm for Mistassini area whitefish and 40-45 cm for Waswanipi area whitefish.

On the coast the picture is more complicated. In the area around the Fort George (Chisasibi) community, 22-44 cm whitefish and 24-36 cm cisco were caught mainly by

the use of 2.5 and three-inch gillnets. In Eastmain 28-42 cm whitefish were caught mainly with three-inch gillnets. North of Fort George, 30-46 cm whitefish were caught mainly with three-inch gillnets in the Seal/Capsaouis River area, and 44-62 cm whitefish with four and five-inch gillnets in the Cape Jones area (Berkes, field notes). Modal lengths were 50 to 60 cm for lake trout in most of the Northern Quebec lakes sampled by Power and Gregoire (1978). The mean weights, by region and by species, in the James Bay area are given in Fig. 2.

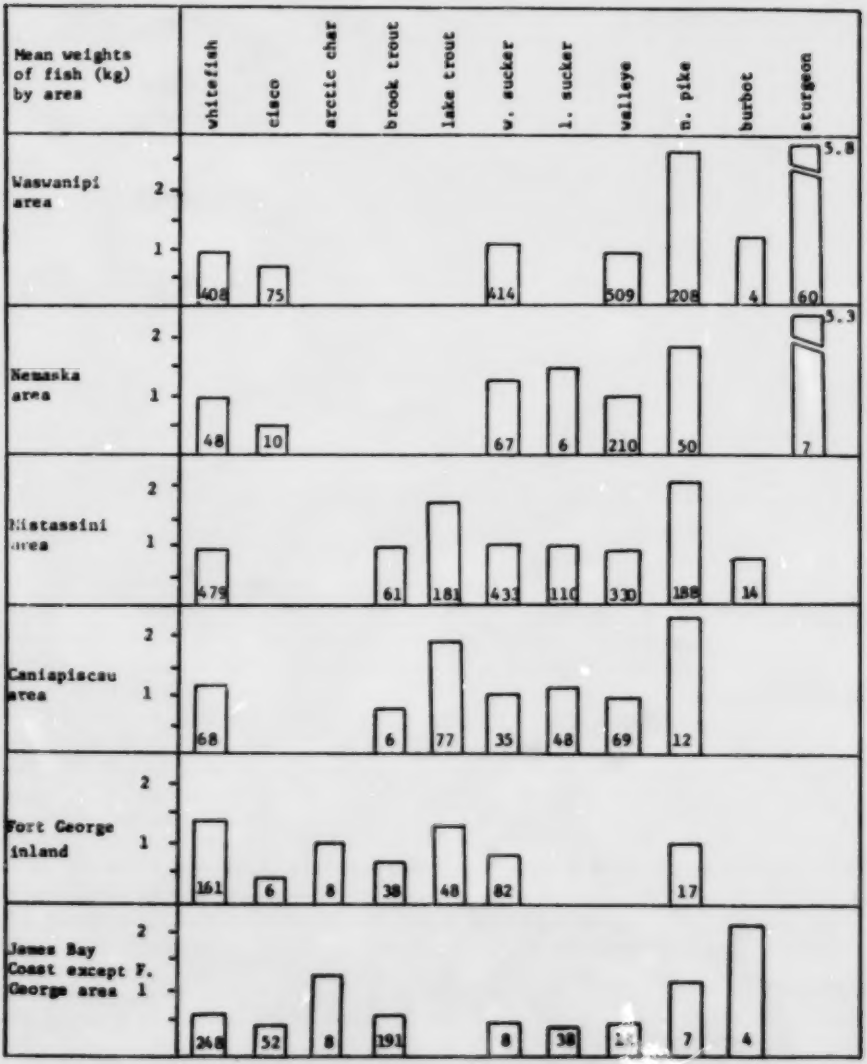

Figure 2. Size of fish by area and by species in James Bay. From data of Penn (1978) and Berkes (unpublished). The numbers in the bars refer to the sample size.

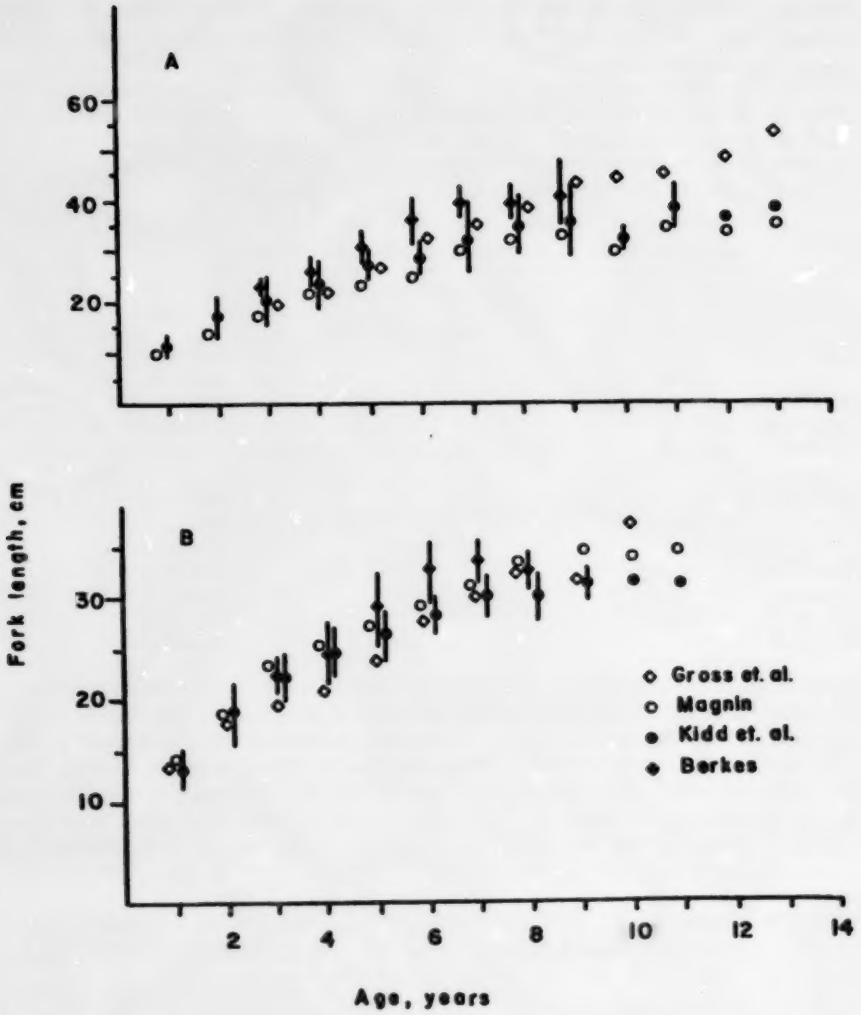

Figure 3. Growth curves of whitefish (Panel A) and cisco (Panel B) from the lower LaGrande River and estuary. Only the mean length is given in Gross et al. (1974) and Magnin (1977a). The mean ± 1 SD are given in Kidd et al. (1975) and Berkes (1977b).

Growth rates for these species are typically slow. Using the scale method for age determinations, consistent results were obtained in four independent studies on Fort George area whitefish and cisco for up to ten years of age (Fig. 3). Since the scale method tends to underestimate the age of slow growing, older fish, Power (1978) used otoliths, and determined that lake trout and whitefish in northern Quebec did not reach maximal sizes until about 20 years, and that the oldest fish were some 40 to 60 years old, not 21 to 27 years old as had been reported earlier from the NWT. While Power's conclusions for these

two species may be considered controversial, it has been firmly established by Magnin (1977b), using the finray section method that sturgeon do reach such great ages.

With information on the average size of fish in the harvested populations and the growth rates, the age at various sizes can be estimated (Table 2). Given the usual constraints in such estimates, the average sizes of fish caught correspond to the following ages: about 10 years for whitefish, white sucker, longnose sucker and pike; 10 to 15 years for walleye; 10 to 20 years for lake trout; and 25 to 40 years for sturgeon.

Table 2. Age at various sizes for James Bay area fish populations.

	number of years to reach					
Stock of fish	250g	500g	1 kg	2 kg	5 kg	Source
Lower LaGrande cisco	6	9	—	—	—	Berkes (1977)
Lower LaGrande whitefish	5	8	—	—	—	Berkes (1977)
Sakami R. whitefish	6	8.5	—	—	—	Magnin (1977a)
Nottaway R. Basin whitefish	3.5	5.5	9.5	—	—	Magnin (1977a)
Nottaway pike	3.5	5	7	11	—	Magnin (1977a)
Nottaway longnose sucker	3.5	5.5	9	—	—	Magnin (1977a)
Nottaway white sucker	3.5	5	8	15	—	Magnin (1977a)
Nottaway walleye	4.5	7.5	13.5	—	—	Magnin (1977a)
James Bay area lake trout	5.5	7.5	9	19.5	—	Magnin et al. (1978)
LaGrande burbot	6	8	11	—	—	Magnin & Fradette (1977)
Lac Waswanipi sturgeon	—	—	8	12	25	Magnin (1977b)
LaGrande sturgeon	—	—	14	23	37	Magnin (1977b)

A harvest based on 10 year-old or older fish implies that the turnover rate is low. If each age-class up to ten represented equal biomass (a conservative oversimplification) then only about one-tenth of the total biomass can be taken per year. Some studies in the NWT have postulated a "production to biomass ratio" of 1:10. The findings for many James Bay area stocks appear to be consistent with this. That is, for a given water body, only about one-tenth (or less) of the biomass or standing stock of fish can be taken per year on a sustainable basis.

Table 2 also indicates that fairly intensive fisheries such as LaGrande whitefish and cisco fisheries are not really based on faster-growing fish. Rather, these fish are harvested at a small size and at five to 10 years of age, the larger fish being absent.

Estimating the Fishery Potential of the Area

There are a number of techniques for estimating fish yields and productivity. Regier (1978: 36) lists no less than ten such approaches, many of which require detailed biological data that are not available for the James Bay area or for most of Canada's North. One approach that has been suggested for use in the James Bay area is the "morphoedaphic index" (MEI) which has the advantage of simplicity. The index is based on only two parameters, mean water depth and total dissolved solids (TDS), both related to nutrient availability (Ryder et al. 1974).

While it is generally agreed among specialists that the MEI formulation is overly simple, its use as a predictor of fish yields has been relatively successful and widespread, es-

pecially in Ontario (e.g. Adams and Olver 1977). No systematic attempt has been made to apply MEI to James Bay area lakes for lack of data. However, information compiled by Feit (1978) and Magnin (1977a, Appendix 1.11, converted from conductivity values, p. 31) permit some preliminary calculations.

Table 3. The range of fish yield estimates for James Bay area lakes based on MEI. For example, a lake with 10 mg/L or ppm Total Dissolved Solids (TDS) and 5m mean depth will have an estimated sustainable fish yield of 1.4 kg/ha/yr.

TDS, Mg/L	Mean depth, m			
	5	10	15	20
10	1.4	1.0	0.8	0.7
20	1.9	1.4	1.1	1.0
30	2.4	1.7	1.4	1.2
40	2.7	1.9	1.6	1.4

Calculation: Based on the simplified formula of Ryder et al. (1974):

$$X = \frac{TDS}{\text{mean depth}}$$ where X is the morphoedaphic index, TDS is in mg/L, mean depth is in m (1)

$$Y \cong 0.966 \sqrt{X}$$ where Y is yield, kg per ha (2)

Table 3 is a matrix of potential fish yield estimates under different assumptions of mean depth and TDS. The values range from 0.7 kg/ha/yr to 2.7 kg/ha/yr. The lower values are more applicable to Caniapiscau area lakes, upper LaGrande basin and Great Whale River areas, and the higher values more applicable to Waswanipi, Nemaska, Rupert House areas and the shallower lakes of the Mistassini area. In the more turbid lakes, especially "clay belt" lakes of the southwest, the MEI would overstate the potential (Ryder et al. 1974). Nevertheless, these values are, on the whole, comparable to the yield estimates (range 0.56 to 2.64 kg/ha/yr) compiled by Power and Le Jeune (1976).

By comparison to these potential yield estimates, the *actual* yields, calculated from harvest data, are considerally lower. In the case of the LaGrande River estuary, there is evidence of overfishing (Berkes 1979) at harvest levels around 0.9 to 1.4 kg/ha/yr (Table 4). A similar calculation for the Eastmain River estuary shows that the higher yields, about 0.50 kg/ha/yr, may correspond to sustainable levels.

Since estuaries generally tend to be more productive than lakes, it may be expected that yield levels in lakes are lower than those in the two estuaries. In the case of Waswanipi area lakes, yields averaged 0.16 kg/ha/yr in 1968-70 (Feit 1978). But in the area within a day's travel, the yield was 0.31 kg/ha/yr. Assuming a subsistence harvest similar to those in 1968-69 and 1969-70 and assuming that 80 per cent of the total catch came from the area within a day's travel, the yield in 1965, the peak year of the commercial fishery, was 0.51 kg/ha/yr. Data on catch trends of the commercial fishery after 1965 leave little doubt that the area was overfished at that level of exploitation.

These calculations can be backed up using the more recent harvesting data for Waswanipi or for any of the other communities. As summarized in Table 5, the actual catch levels

are considerably lower than the yields predicted by the MEI. Most MEI estimates fall in the range of one to three kg/ha/yr, but such yields are almost never reached except in the most intensely exploited and naturally productive areas as the LaGrande estuary. In the case of the Waswanipi area, for example, the predicted yields would be about two kg/ha/yr, and yet sustainable catches seem to be 0.3 to 0.4 kg/ha/yr. The discrepancy between these potential and actual yields may be explained in two ways. First, many James Bay area fisheries do not fulfil one of the important criteria for the use of the MEI which is, "moderately intensive to intensive fishing effort on a spectrum of species for a number of years" (Ryder et al. 1974, p. 669). Most Cree subsistence fisheries, as reviewed in the previous section, are selective and are based mainly on the larger individuals of slow-growing species. Second, the MEI formulation used here is derived mostly from data on temperate and boreal lakes, and needs to be revised when applied to subarctic and Arctic lakes. There appears to be accumulating evidence that temperature differences explain a large part of the observed differences in lake productivity (H.A. Regier, personal communication).

Table 4. Estimated catches and yield per area, the lower LaGrande River.

	1973-74[4]	1974-75[5]	1975-76[6]	1976-77[7]	1977-78[8]	1978-79[9]
Total Fort George catch	170,720	173,349	116,680	64,649	66,248	102,762
Catch from the lower LaGrande, by numbers[1]	53,055	53,738	36,171	20,041	20,537	31,856
by weight[2] (kg)	16,000	16,207	10,909	6,044	6,185	9,608
Yield per area[3] (kg/ha)	1.33	1.35	0.91	0.50	0.52	0.80

[1]Assuming that the lower LaGrande catch is 31 per cent of the total Fort George catch. (Weinstein 1976: 96, 196).
[2]Assuming 301.6 g per fish (Berkes, field notes).
[3]Assuming 120 sq km of available habitat for the fish stocks.
[4]Weinstein (1976).
[5]NHR (1976).
[6]NHR (1978).
[7]NHR (1979a).
[8]NHR (1980).

Total Production vs. Harvest Levels

Power and Le Jeune (1976) produced an estimate of the total fish production by assuming that the total area of Hudson/James Bay and Ungava Bay drainage basins was 876,000 sq km, and water surface 25 per cent of this or 219,000 sq km. Using various yield per area estimates from the literature, they arrived at a total fish production figure of 12 to 58 million kg per yr. This, they pointed out, was some two orders of magnitude greater than the actual total catch of subsistence, commercial and sport fisheries of the area (about 400,000 kg per yr), and concluded that there must be a great unutilized fishery potential in the area.

However, the productive water surface may only be about 10 per cent rather than 25 per cent; a detailed planimeter study of the Waswanipi area used by Feit (1978) found the water area to be 10.9 per cent of the total surface. If this is so, and if two-thirds of the area supported one kg/ha/yr and the rest two to three kg/ha/yr (consistent with MEI estimates), then the yield estimate must be revised to 12 million kg per yr.

Table 5. Summary of actual fish yields in the James Bay area, based on various estimates of subsistence and commercial harvests.

	Yields kg/ha/yr		
	Mean	Range	Comments
Lower LaGrande River and estuary, 1973-79	0.90	0.50 – 1.35	probably overfished until 1975
Lower Eastmain River and estuary, 1975-79[1]	0.32	0.19 – 0.53	probably underfished
Waswanipi area, entire, 1968-70[2]	0.19	0.16 – 0.21	probably underfished
Waswanipi "near" zone 1965, year of peak commercial fishery[2]	0.51	–	overfished
Waswanipi "near" zone 1968-70[2]	0.31	0.27 – 0.36	recovering from earlier overfishing?
Waswanipi "near" zone 1974-75[3]	0.39	–	sustainable catches?

[1]Calculated on the basis of NHR data for the number of fish harvested, assuming 415.7 g per fish (Berkes, field data), assuming that the area accounts for 50 per cent of the community harvest, and assuming 100 sq km of available habitat for the fish stocks.
[2]From Feit (1978), assuming 2,590 sq km of water surface, 1450 g per fish; excludes sport fishing.
[3]Calculated on the basis of NHR data for food weights harvested, corrected to whole weights and assuming that 80 per cent of the total community catch came from the "near" zone.

Table 6. Fish harvests in James Bay and northern Quebec in the mid-1970's. Inland fish excludes sea-run stocks.

	All fish, kg per yr	Inland fish, kg per yr
Cree harvests	320,000[1]	240,000[2]
Inuit harvests	233,000[3]	58,000[4]
Other harvests[5]	100,000	50,000
	653,000	348,000

[1]On the basis of 1974-75 (NHR 1976: 334, 362) converted to kg and corrected to whole weight units. The following two years show a sharp decline (presumably due to the mercury scare) followed by partial recovery.
[2]Assuming 75 per cent of the total catch comes from inland stocks, on the basis of species composition of harvests.
[3]On the basis of 1976 data which is considered more representative than some of the earlier years (L. Brooke, pers. comm.) converted to kg and whole weight units. Includes commercial catches.
[4]Assuming that 25 per cent of the total catch comes from inland stocks, on the basis of species composition of harvests.
[5]Mainly sport harvests and Naskapi harvests. Based on Power and Le Jeune (1976) and educated guesses. Accurate data not available.

Using assumptions more consistent with actual yields, 0.4 kg/ha/yr in the northern and northeastern two-thirds of the area, and 0.6 to 1.0 kg/ha/yr in the rest (much of the James Bay area south of the LaGrande), the estimate of harvestable fish production becomes five million kg per yr.

Actual harvests in the area may be estimated from the results of the Native Harvesting Research Study. These catches add up to about 650,000 kg per yr, of which the inland fish (not including sea-run stocks) account for about 350,000 kg per yr or some seven per cent of the estimated yields (Table 6).

Since the sea-run stocks such as arctic char, salmon, brook trout and whitefish do use freshwater habitat and feed to some extent in freshwater, a fraction of the harvest of sea-run stocks must be considered as part of inland production. Taking this into account, it may be concluded that harvest levels in the mid-1970's took about 10 per cent of the estimated yields and not one per cent. The weak links in these estimates are the size of productive water surface, and the relative importance of the more productive stream (Leclerc and Power 1980) and estuarine habitats to lake habitats.

Some Characteristics of Subsistence Fisheries

While the fish resources of the area *as a whole* are doubtless under-utilized (but not as much as previously thought), present catches come from a relatively small area. Harvesting close to theoretical yields is nearly impossible since fishing effort is not distributed evenly through the area. Rather, the fishing effort (defined here as manpower and fishing gear applied to catching fish for a specific unit of time) tends to be concentrated in space and time.

Native harvesters tend to fish when the expected catches per unit of fishing effort are high in comparison to those from other subsistence activities. This phenomenon has been documented for Fort George fisheries (Berkes 1979), and the findings are consistent with the general predictions of "optimum foraging strategies" in theoretical ecology. Since native people cannot afford — in terms of time — to fish when they are not obtaining adequate returns, and since they tend to have a limited amount of gear, they select situations when fish are easy to catch. Thus, traditional native fisheries concentrate, year after year, on the same pre-spawning aggregations, feeding or over-winter concentrations, migrating or spawning populations, at specific times and places.

Hence, subsistence fisheries are characterized by relatvely high catches per unit of fishing effort, for example, per length of gillnets used (Berkes 1979). However, they are also characterized by small amount of gear used, low catches per day and per fisherman, as compared to commercial operations.

This efficiency (defined here as the catch per unit effort) of the subsistence fishery is offset by the fact that fishermen have no incentive to create a surplus; the Cree catch only as much as they need (Berkes 1977). Moreover, among the Cree, a good fisherman (or hunter) is someone who catches what he needs, not necessarily someone who catches a great deal (Feit 1978).

Native subsistence fishermen do not practice "conservation" as biologist define it; they say "they only fish as they know how." Many of their practices are ecologically adaptive in the sense that they help maintain relatively large and efficient catches without depleting the stocks. Several of these practices have been described and discussed in terms of fishery management principles (Berkes 1977). These include the practice of "rotating" harvested areas within a trapline or family hunting territory, thereby allowing some populations to recover.

Such a land tenure and resource-use system evolved, presumably, in a manner which is well adapted for the maintenance of a low human population density over a large area. With the policy of the 1950's and the 1960's to draw native populations into permanent settlements, fishing began to be concentrated, increasingly in limited areas around communities. Although some traditional fishing practices continue to be used, other considerations play a part in fishing activities: because of community living and wage employment, weekend fishing becomes common. For those still living mainly off the land, families with many children cannot undertake the arduous journeys of the old days and tend to use modern transportation technology (and much money and fuel). If families are left in the village, men establish temporary camps and ferry their harvests using modern transport.

Problems of Fishery Management in James Bay

Problems in the maintenance and utilization of fishery resources in the study area may be conveniently discussed under seven headings.

1. Impact of subsistence fisheries.

Several studies have commented on the phenomenon of concentration of hunting, fishing and trapping activity near settlements (Lotz 1976; Usher 1972). Weinstein's (1976) work in Fort George shows the striking concentration of fish harvests (and presumably the fishing effort) along the James Bay coast and the lower LaGrande River in 1973-74. Since then, access patterns have changed greatly, due to the construction of new roads associated with the hydroelectric project, and fishing effort has been concentrated along these roads. But the principle remains the same: fishing effort tends to be localized in a few areas and the rest of the area is fished lightly.

Such concentration of effort results in overfishing. For example, overfishing of whitefish around Fort George (population 2,000 in 1980) may be deduced from the low catch per unit of effort, smaller average size of fish and fewer mature year-classes, as compared to control areas (Berkes 1979). Such evidence shows that a medium-sized northern settlement can have considerable impact on living resources in the surrounding area. It is not surprising that similar cases of local overexploitation have been observed in the area of the larger settlements such as Waswanipi (Feit 1978), Great Whale and Fort Chimo (Berkes, field notes), but not the smaller settlements such as Eastmain (Berkes, field notes).

2. Impact of commercial fisheries.

Commercial fisheries were set up throughout Northern Quebec in the 1950's and the early 1960's in an attempt to develop local economies based on renewable resources. Power and Le Jeune (1976) indicate that these fisheries were established on the basis of making the operations economically feasible, rather than biologically sustainable. These fisheries reached peak harvests of almost 50,000 kg in 1963, but many of them, especially those based on arctic char, subsequently collapsed without ever having reached the quota levels. Some of the fisheries still persist in the Ungava Bay area.

In James Bay, commercial fisheries resulted in the depletion of several stocks, especially sturgeon, for example in the Waswanipi, Rupert House and Sakami Lake areas. Data compiled by Feit (1978) document the sequential depletion of stocks in the Waswanipi area in a manner well known to fishery ecologists as the "fishing-up sequence" (Loftus and

Regier 1972). The operation began in Waswanipi Lake in 1958, and by 1963 the sturgeon, which is the largest and the most valuable species, was depleted. The fishery was extended to several other lakes and fishing for sturgeon continued, supplemented by catches of the lesser-valued species. Catches peaked in 1965, by this time concentrating mainly on whitefish and walleye in a number of lakes. Subsequently, harvest records showed a further five-fold decline in sturgeon between 1965 and 1969, and a three-fold decline in the total catch between 1965 and 1970, at which time the entire fishery was closed down due to high mercury levels.

3. Impact of recreational fisheries.

Sport fisheries tend to cause over-exploitation for much the same reasons as subsistence and commercial fisheries: they are often concentrated in a few accessible areas, attracted by the availability of large fish, and do not relocate until after the damage has been done. Overfishing caused by sport fisheries in Quebec is almost impossible to document for the lack of data. The Government of Quebec, in what appeared to be a regressive step to many fishery managers, abolished fishing licenses in 1977. At the present there is no way to monitor sport fishing activities, except those carried out through licensed clubs.

The potential for damage to the stocks and for conflict with native users may be deduced from the distribution of accessible roads, outfitting clubs and non-native workforces (SEBJ 1978). In the James Bay area, the Cree have simply abandoned the use of lakes near work-camps.

A good example of resource-use conflict comes from the Deception Bay area, near an asbestos mine, in eastern Ungava. A study carried out by federal government personnel to investigate Inuit complaints, estimated that the asbestos workers took 3,000 to 30,000 arctic char per year, as compared to 20,000 taken by the nearest Inuit community, Sugluk, over their entire area (NHR 1979b: 50).

4. The problem of mercury in relation to acid precipitation and flooding.

Mercury levels in the James Bay area have been known since 1970 to be relatively high. Predatory species (northern pike, walleye and lake trout) tend to exceed 0.5 ppm mercury, the standard for the commercial sale of fish. Non-predatory fish such as whitefish contain less than 0.5 ppm except in parts of the Waswanipi area directly affected by mercury pollution (Penn 1978). There have been no known cases of mercury poisoning in the area, although a few cases of relatively mild neurological symptoms possibly related to mercury have been found in epidemiological studies.

The rate at which mercury enters food chains in part depends on water pH levels. Much of James Bay and Northern Quebec is on the Canadian Shield, an area which is geologically susceptible to acid precipitation. Available data on water pH in James Bay area lakes show values mostly between 6.0 and 6.5 (Magnin 1977a, p. 45) which is somewhat acidic, but it is not known if there has yet been a measurable effect from acid rain.

There is some evidence that flooding may cause an increase in mercury levels, presumably due to leaching. Bodaly and Hecky (1979) found that mercury in fish increased two to five-fold from 1975 (pre-flooding) to 1978 (post-flooding) in Southern Indian Lake, Manitoba. Similarly, Bruce and Spencer (1979) found that fish from the Smallwood

Reservoir (flooded 1971) and affected water bodies, on the average, contained about twice as much mercury as those from waters outside Smallwood Reservoir influence.

Even without acid precipitation and flooding, it has been hypothesized that high background levels of mercury may be a general phenomenon in the North because of long periods of snow cover, little topsoil and the known mechanism of trace metal migration from bedrock through snow (Eaton 1979).

5. The question of harvestability of reservoir fish production.

Flooding of land creates new lake ecosystems, and it has been known from studies elsewhere that productive fisheries may develop in pre-cleared reservoirs. Decomposing organic matter releases nutrients, leading to a "trophic upsurge", eventually to be followed by "trophic depression" as nutrients are locked up in living matter. Recent work indicates that in the boreal zone "trophic depression" comes early, caused by soil humic matter immobilizing certain key minerals such as iron (Jackson and Hecky 1980).

In the case of the James Bay area reservoirs, very little of the flooded area has been cleared. It is necessary, therefore, to make a distinction between the potential productivity of reservoirs and the physical suitability of these reservoirs for harvesting.

In the first two years of the LG-2 reservoir (1979-81) no fishing had been done in the reservoir area by the Crees. The following reasons were cited for not fishing: problems of access, the effect of unpredictable changes in water level (drawdown) and floating logs on transportation and fishing gear, and lack of known fishing sites. It is a major problem, therefore, to make reservoirs in Canada suitable for fishing. By contrast, in northern Europe where the multiple-use approach has a longer tradition reservoir management is a well-developed science.

6. The effect of development on native land tenure.

The hydro project also has affected native fisheries indirectly through the impact of the project on the native land-tenure system. The more obvious impact is the flooding of land which deprived some native "tallymen" (holders of government-recognized trapping rights) of their land. Less obvious is the impact of the road network associated with the project on traditional land-use patterns (Berkes 1981). These roads were welcomed by many of the tallymen because they facilitated transportation to their lands. But since specialized knowledge of the land was no longer necessary to get to those areas, access was facilitated for all; and this, in some areas, has caused conflicts, especially in fur animal harvests.

7. Heavy reliance on mechanized transport and fuel subsidies.

Harvesting the sparse biological productivity of large areas from permanent settlements requires mechanized transport and large fossil fuel energy subsidies. In Fort George Cree subsistence fisheries, for example, it has been estimated that 14 to 22 kcal of energy input are required to harvest one kcal fish protein (Berkes, in progress). As energy costs climb and as accessible areas may already be depleted of fish and game, major problems may face the Cree subsistence economy. Other factors, such as the Income Security Program for hunters and increased employment for the Cree in other sectors of the economy will no doubt complicate this picture.

Fishery Resource Allocation Policy and Economic Development

In the James Bay area in the 1970's, the major use of the fishery resource was in subsistence fisheries. In 1974-75, the fish harvest represented about one-quarter of the total potential bush food by weight, and about half of the minimum adequate protein requirement for the Cree population (Berkes and Farkas 1978). While the exact harvest figures may be debated, the value of fisheries in the regional economy is obvious. However, this value is not reflected in the cash economy. Only a negligible amount of the harvests enter the local market economy, and none go to external markets. The potential of future economic activity related to the fishery resources is intimately tied to the management and allocation mechanisms of the James Bay Agreement.

According to the Agreement, native people have exclusive harvesting rights in Category I and II lands (see Fig. 1). In addition to this, in the remainder of the area (Category III), they have exclusive rights over the following fish species: whitefishes (non-anadromous), sturgeon, suckers, burbot and hiodons (mooneye and goldeye). Many of the remaining species are predatory, and tend to be valued by sport fishermen as well as native fishermen. Thus, it may be predicted that resource-use conflicts between native and non-native groups will occur over these species (brook trout, lake trout, salmon, arctic char, pike and walleye) mainly in Category III lands. Conflicts between native and recreational interests in Quebec have been coming into public view in recent years, especially in the Quebec North Shore area (Gulf of St. Lawrence).

The basis of allocation policy in the Agreement is to conserve native subsistence resources, and to give priority to subsistence use, while safeguarding non-native rights as well. This is done by means of establishing the "guaranteed levels of native harvesting" (Agreement, Section 24.6.2) based on the Native Harvesting Research study (NHR 1976, 1978, 1979a and 1980), the "principle of priority of native harvesting" (24.6.3), and the "principle of conservation" (24.2). These provisions have not yet been operationalized, and the ongoing James Bay hydro development, which will proceed into the 1990's, appears to be eroding the land and resource base in a piecemeal fashion (Berkes 1981).

Other provisions of the Agreement may also affect fisheries directly or indirectly. The Income Security Program (Section 30) has boosted fishing and hunting by providing a cash income for those who choose to pursue a "traditional" way of life. The development of native-run commercial fisheries for local markets may be facilitated by the definition of "harvesting" (24.1.13) which appears to include fishing for community purposes as well as for personal purposes. The outfitting regime in the Agreement reserves a major share of hunting and fishing camp operations for the native people.

Despite these provisions, income-generating economic development based on renewable resources has not occurred among the Cree in the first five years of the Agreement. There has been no increase in the number of Cree-run outfitting camps and, in contrast to the Northern Quebec Inuit, there have been no commercial fisheries, nor any attempts to manufacture speciality products (such as smoked fish). Part of the reason may be that economic development based on living resources does not clearly fall under the jurisdiction of any one agency of the regional Cree government created by the Agreement; it seems to have been caught in the "no man's land" between the Traditional Pursuits Agency and Economic Enterprises Agency.

Discussion

The argument in this case study paper follows the usual scientific resource management paradigm: there is an account of the stocks, some estimation of the total allowable catch, a comparison of the total annual harvest with the presumed sustainable yields, and an evaluation of management problems and other complicating factors. The approach is comparable to that of Fuller and Hubert (this volume). The other approach, management by local community control, is seen as a complementary, rather than alternative, approach. For example, the potential for management by local control of land and resources in the James Bay area as part of integrated management has been evaluated elsewhere (Berkes, this volume).

In dealing with a relatively small area and one group of species, as compared to Fuller and Hubert's treatment of a larger area (all of the N.W.T.) and all species, there is a better opportunity to estimate levels of productivity and harvest, and to elucidate management issues.

One advantage in considering fisheries as a case study is the availability of the Morphoedaphic Index which provides a powerful tool, empirically verified in some areas, for the estimation of sustainable yields. No comparable index exists for other groups of species, although there are indications that such indices may be developed. Nevertheless, MEI estimates of fish productivity in the North are not very reliable. Material reviewed in the present case study suggests that this situation may be improved by adjusting the index to take into account possible temperature effects and the fact that most northern fisheries are based on what may be ecologically considered "climax" communities, consisting of slow-growing, large individuals, and a low productivity ÷ biomass ratio.

It would be possible to increase total fish production (yield per area per year) by intensifying the fishing effort, but this would lead to an alteration of the species composition and a loss of long-lived slow-growing species. The theoretical foundations of this phenomenon are fairly firm (Loftus and Regier 1972). Thus, there are two policy alternatives in northern fisheries management: (a) for maximum yield, intensify the effort and alter species composition, or (b) settle for an optimum yield which is smaller than the maximum yield but which is based on large individuals of slow-growing species such as lake trout — preferred species which can be harvested by relatively smaller fishing effort. It is important to note that, to native subsistence fishermen, overfishing means the lack of large-sized individuals of the desirable species.

The fishery resource base in James Bay and Northern Quebec is relatively large and under-utilized. As with the N.W.T. (Fuller and Hubert, this volume), there is greater productivity potential in fish than in other animal groups. Furthermore, throughout the North, the virtual elimination of dog teams in the 1960's released the supply of fish for human consumption; the slack has probably not yet been taken up by population growth.

A major issue in current fisheries management is therefore not population growth (a long-term problem) but urbanization (a long-term and short-term problem). Concentration of native populations in permanent settlements has disrupted the relatively even distribution of fishing effort over extensive areas, and intensified fishing around few accessible areas, resulting in local overfishing. The new settlement pattern also left native fishermen/hunters heavily dependent on mechanized transport, as identified also in the N.W.T. Science Advisory Board reports summarized in this volume by Fuller and Hubert.

The resulting increase in energy and capital costs of harvesting must be flagged as a continuing major long-term problem, the negative impacts of which are in evidence at the present time.

The concentration of the native population in permanent settlements has also created conditions conducive to the development of local markets for commercial fisheries. A development model for native northern commercial fisheries may involve the advent of specialized fishermen, working full-time in selected seasons, utilizing rapid transport and accumulating a surplus. The fisheries would be rotational ("pulse-fishing" of Adams and Olver 1977), harvesting the accumulated growth of many years from a given lake and then moving on to others, a pattern very similar to traditional Cree and other northern native practices. This development model is not a prediction but a logical extension of the recent experience in the James Bay area.

Such fisheries would be ecologically viable and socially desirable. The Waswanipi experience (Feit 1978) showed that commercial fisheries can be made compatible with the Cree way of life. Fishing seasons and working hours were flexible, there were opportunities to involve the entire family in fishing, and to take time off to participate in other subsistence activities. These considerations made commercial fishing relatively more attractive, despite low returns in the 1960's, than most other kinds of wage labour.

Much of the above is relevant not only for the James Bay area but the entire North. Two more points will be introduced to reinforce this and, further, to highlight the fact that management is a bigger issue than can be handled completely at the local level. First, some important and interrelated environmental problems transcend local control: for example, mercury in fish and acid precipitation. In the James Bay area, mercury in fish is also affected by inundation of land; flooding and the construction of the road network both affect access patterns, and hence native land tenure and the balance between native and non-native users of the resource.

Second, there is increasing non-native interest in northern fish and game, and an impending squeeze on these resources. The pattern of increasing conflict is more apparent now in the northern areas of such provinces as Ontario than north of 60°. However, northerners and managers may well take note that expansion by non-native Canadians in energy developments and mining, and now, even recreation, has been taking place at the expense of native land and resource rights. Further, many of the critical northern living resources (including Pacific salmon, many of the caribou populations and most waterfowl species) cross jurisdictional boundaries, and are harvested by several user-groups, making it impossible for management at the local level only.

Biological management, which is necessary, is nevertheless only the first half of the northern fisheries problematique. The second half, allocation, is mainly a political matter, and goes beyond the realm of competence of natural science. While biological management is a relatively straight-forward issue, as shown in this paper, the real challenge is to work out allocation mechanisms that would be basically acceptable to all user-groups, and to respond creatively to the special circumstances of the North.

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IS THERE A POTENTIAL FOR CANADIAN NORTHERN AGRICULTURE? (A Justification for Research on Northern Native Plants as Potential Foodcrops)

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Introduction

The culture and lifestyle of Canada's northern native people has been radically altered by the recent influx of people, resources and technology from the south. A decline in the utilization of natural resources by the Inuit has coincided with the settlement of traditionally nomadic families into fixed communities where southern energy and food supplies are readily available. The establishment of a food economy based on imported resources has resulted in serious nutritional and economic problems. Future Canadian northern policy should therefore seek to encourage programs leading to economic self-sufficiency in food and energy resources.

In this paper, we propose that (1) the current dependence on southern food products could be reduced by a return to the use of northern plant and animal resources, that (2) edible tundra plants are potentially cultivatable crops, and (3) that there is a need for a Canadian Northern Agricultural Institute to effectively research and develop the northern food economy.

Current Northern Problems

Nutrition. Increased availability and utilization of imported foodstuffs, a consequence of northern development, has provided the native people with greater caloric intake and more product variety but has coincided with a marked decline of traditional hunting and gathering. The proximity of community food stores has greatly facilitated the once arduous process of acquiring food, but has also resulted in rapid and uncontrolled diet changes. In recent years, these changes have been deleterious to the health of the native people.

The traditional high-protein Inuit diet consisted primarily of meats acquired from both land and sea mammals, while carbohydrates, which constitute the bulk of southern diets, were rarely consumed (Williamson 1971). The traditional methods of food preparation which survived for countless generations, had ensured effective vitamin preservation and utilization of valuable minerals (Rodahl 1950). Currently however, the northern consumer must rely heavily on canned, frozen, or dry-processed foods since fresh produce is seldom available. Carbohydrates have replaced proteins as the principal food constituent and the intake of sugars has risen dramatically (Schaefer 1975). The decreased utilization of local plant and animal resources as well as changes in food preparation techniques have resulted in a loss of several essential vitamins and minerals from the native diet.

The recent increase in Inuit health problems can be directly attributed to the new diet (Schaefer 1973). As early as 1948, clinical deficiencies of ascorbic acid were found in

one-third of the population of Southampton Island (Brown 1949). More recently, the Nutrition Canada Eskimo Survey (1975) reported low blood serum levels, i.e. inadequate Vitamin C uptake, in all age-groups except children under five. Vitamin A, C and D uptake by northern peoples was found to be below the national average. The incidence of obesity, diebetes, acne, heart disease and dental decay have increased concurrent with new dietary practices (Schaefer 1971, 1973).

Dietary programs relevant to northern situations must be developed to ensure good health in future Inuit generations. More effective education is required so the native peoples can properly utilize imported southern foods. However, if fresh foods became increasingly available through development of local northern resources, reduced reliance on imported food could become a reality.

Economics. In addition to dietary concerns, the strong dependence of northern communities on food sources that are up to 3,000 km distance poses quality and price related problems. The transport of fresh goods over long distances often involves cargo changes, overnight stops and delays due to changing weather conditions. As a result, produce arriving in northern communities is often of poor quality. For this reason, distributors select long-lasting and quick-selling foodstuffs which limits product variety to the consumer.

The prohibitive food prices in northern stores, primarily due to high transportation costs, impose a tremendous economic burden on the government as well as northern consumers. For example, four small tomatoes sold in Frobisher Bay for $1.40 (Webb 1977), and a sack of potatoes in Aklavik cost $20.22 (Hunt 1978). Lettuce in Rankin Inlet was $2.00 per head, and a small bunch of bananas was priced at $5.00 in 1980. During the same year, one month's food bill for a family of seven in Pelly Bay, N.W.T. was $1,526.70 or approximately $51.00 per day (Toronto Star 1981).

It probably remains more economical at present to import food than to produce it locally, but as the northern population continues to grow and costs of essential foods rise even higher, the conversion to use of local resources and means of producing them will become increasingly relevant. Programs should be initiated now, and not once the demand for alternative food sources become too great.

Potential Solutions

Historically consumers' needs in many areas in the world, including the Arctic, have been met by local resources. A logical step towards alleviating the problems of the current food economy would lie in a return to utilization of resources provided by the northern land. Self-sufficiency and maintenance of the Inuit hunting culture could be partially attained by the management and controlled harvest of arctic animals such as caribou, musk-ox reindeer, whales, walrus, seal and fish. The successful herding of reindeer by the Lapps in Finland provides an instructive example. Complementary projects should involve the development of intensive greenhouse and gardening programs in the north. The cultivation of edible plant species would provide important additional fresh produce currently lacking in the northern diet.

Native Plants

The arctic tundra is rich in edible plant species (Porsild 1953) which the Inuit used according to seasonal abundance. Greatest utilization traditionally occurred in arctic

regions where vegetation was most abundant (Weyer 1932, Schaefer 1975). The use of plants by the Aleuts, West Greenland, and Labrador Inuit has previously been well documented (Hawkes 1916, Weyer 1932, Anderson 1939, Oswalt 1957, Hertz 1968, and Ager and Ager 1980).

Vitamins and minerals contained in edible tundra plants contributed to the maintenance of a balanced diet for the Inuit (Schaefer 1975). High levels of Vitamins B_1 and C occur in several tundra species (Rodahl 1944 a,b) and those considered delicacies by the Inuit contained the highest levels of Vitamin C (Rodahl 1950). Other information concerning the nutritional value of arctic plants is limited. The renewed utilization of these native plants by the Inuit would assist in returning important nutrient inputs currently missing from the diet.

Northern species are adapted to the low temperatures, extended photoperiod, cold soils and occasional frosts of the summer growing season, in contrast to southern vegetables which require protection if grown under these conditions. The growth of arctic plants is usually suboptimal however, and could be improved by amelioration of certain environmental factors such as temperature and soil nutrient supply (Billings and Mooney 1968). The results of amelioration can be seen in the lush growth occurring around fox dens and rodent habitations (Russell 1940).

We found that simple ameliorative techniques (including styrofoam insulation, polyethylene tent covers and nutrient fertilizer) greatly improved soil nutrient status and enhanced microclimatic conditions within cold frame plots at Rankin Inlet during 1979 and 1980. Native species transplanted and grown under these improved conditions increased their yields four to 25-fold over plants sampled from selected natural habitats (Table 1). Temperate leaf crops grown under similarly enhanced conditions produced yields comparable to those of northern species but considerably lower than could be obtained in southern regions.

	Natural Tundra Site	Nutrient/Temperature Ameliorated Cold Frame Gardens
Taraxacum lacerum	2.00	16.7
Oxyria digyna	0.38	10.2
Saxifraga cernua	0.27	1.6
Viking spinach	—	9.9
Buttercrunch lettuce	—	7.7

Table 1 The final yields (grams dry weight) of arctic and temperate species in soil nutrient and temperature ameliorated cold frame plots and natural tundra sites in Rankin Inlet, N.W.T. during 1979 and 1980 (from Romer *et al.* 1981)

Preliminary results indicate that the potential development of northern species as cultivars is feasible and applicable to the northern situation. Northern plants have traditionally supplemented the Inuit diet, are high in nutritional elements lacking in the current diet, and their yield can be easily and economically enhanced. The cultivation of native edible species as foodcrops would be a new way to use traditional food resources and should be thoroughly examined as a practical possibility.

Temperate Plants

Temperate crops have been successfully cultivated in northern regions. As early as the mid-1600's, gardening ws undertaken in Canada by Hudson's Bay Company outposts and missionaries (Moodie 1978). Recent activity has been greatest in the western arctic regions where climatic and soil conditions have permitted large scale crop production (Hunt 1978; Dearborn 1979).

The establishment of the Alaskan Agricultural Experiment Station at the University of Alaska in 1937 has contributed greatly to knowledge of northern agriculture. Research areas of the A.A.E.S. include crop production, cultivating practices, livestock husbandry, dairy farming, and development of suitable vegetable varieties for northern regions. Strong encouragement and financial assistance provided by government agencies has enabled rapid implementation of these programs which employ citizens and use arable land effectively. As a result, about 500,000 acres of Alaska will be developed for crop production by 1990 (Drew 1981) and the potential exists for vegetable self-sufficiency by this time (Dearborn 1979).

In comparison, Canadian research into the use and development of valuable plant, animal and land resources has been very limited. It has been estimated that there are 15-20 million acres of potentially arable land in the Canadian North which remain largely undeveloped (Ehlers 1970).

Conclusion

There exists the need for a Canadian agricultural research station which would build towards a self-sufficient northern food economy. The vital role which such an institute plays in Arctic development has been clearly demonstrated in Alaska. The establishment of a Canadian counterpart in a northern setting would augment knowledge of cognate nutritional, biological and economic problems in northern Canada and enable us to find solutions.

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The Role of Self-regulation in Living Resources Management in the North

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Introduction

This paper argues that there are basically two alternative approaches to living resources management, and a third representing some combination of the first two. The first is management by regulations established by various government agencies, in accordance with the results of scientific studies and the perceived need to limit the harvest to levels that can be sustained by the game populations. This is referred to as regulation from the outside, as opposed to self-regulation, which is the second approach. In its pure form, the second approach is to leave all management power and responsibility with the local community. This effectively would mean complete de-regulation; its proponents include leaders of some native groups who hold the view that there should be no outside government interference with native hunting, fishing and trapping activities.

The two approaches may be combined in various ways. One such family of hybrid approaches is native participation in scientific studies. Examples may include the employment of northern native research assistants, "cooperative research" undertaken jointly by government and local/regional native agencies, and the development of a northern native scientific community. In each case, native participation would be valuable and sometimes necessary, as these mechanisms would bring native concerns to the foreground, as well as providing the benefit of native knowledge of local resources. These objectives, although worthwhile, are insufficient in themselves if the regulatory mechanism does not involve native participation and if the information so collected ultimately serves only the purposes of regulation from the outside.

Another family of hybrid approaches would be to rely on southern science to set the framework for management, but would then involve the local communities in working out the actual regulations and allocation where allocation may be an issue. Again, user-group participation in management decisions in general, and local native participation in northern living resource management in particular, are valuable and necessary. However, this approach divorces the biological aspects of management, as if the native people had no contribution to make, from the political aspects of management. A major shortcoming of this approach is that the regulatory decisions so taken may lack credibility from the native point of view if there is disagreement on the status of the stocks.

This study mainly deals with another family of hybrid approaches: that which strives to combine self-regulation with regulation from the outside, and scientific resource management with control at the local level. The study will attempt to evaluate the conditions under which one alternative approach or the other may be more appropriate as the major management mechanism for the task at hand. The assumption here is that the desired outcome (the task) is the pursuit of optimum natural productivity of living resources.

The approach will be based on the case study of the Cree Indian people of eastern James Bay and their resources. First, traditional management techniques and practices will be

discussed. Second, the trapline system, as the key "traditional" institution in the land tenure system, will be assessed further. Third, the conditions under which the native land tenure system tends to break down will be evaluated. Next will be an analysis of the appropriate management approaches, by animal group, leading to a discussion of prospects and possibilities of management by design, as opposed to management by outside regulation.

Traditional Management of Living Resources

Many traditional peoples have developed, over time, a body of practices which regulate land and living resource use. Usher (this volume) uses the term "customary law" to denote those social and religious practices which serve, "in fact if not in direct intent to conserve essential resources." The terms "folk science" or "ethno-science" have also been used to mean much the same thing. Feit (1973), for example, utilized the term "ethno-ecology" in referring to the management of moose by the Waswanipi Cree.

Northern native peoples, of course, do not have a monopoly over traditional management. For example, a fantastic array of traditional management techniques (and their subsequent demise) has been documented by Johannes (1978) for the peoples of the Pacific islands. Further, the phenomenon is not absent in non-traditional societies, among contemporary commercial fishermen. McCay (1980) reported evidence of what she called "indigenous resource management" in the U.S. northeast, and Berkes and Pocock (1981) similarly reported evidence of self-regulation among Canadian commercial fishermen in Lake Erie.

In the James Bay area, native traditional management has or had a number of facets:

1. There is local control of the land and the creation of closed-access conditions. This serves to introduce limited property rights (perhaps more accurately, usufructuary rights) into what would otherwise be common property resources.

2. There is a detailed body of knowledge of the local terrain and of the natural history of the animals therein. This specialized knowledge of the local terrain (how to navigate parts of the Fort George coast; how to find a good fishing lake and a good fishing spot) is held by individual family groups, and is important in maintaining closed-access conditions.

3. Animals are harvested according to needs. For example, the virtual cessation of the beluga whale hunt in Fort George (Chisasibi) after 1965 or so is directly related to the replacement of dog teams by snowmobiles.

4. There is vigilance against waste and wasteful practices. For example, geese are utilized very fully (head, feet, fat attached to the mesentery tissue), and the internal organs (except the gall bladder) of the fish are eaten, although these practices have been declining. Traditional hunters abhor the killing and abandonment of animals. But on occasion this does occur; for example, dead beavers have been found along the roadside in the Fort George area since 1974, when the LG-2 road was first constructed.

5. There are conservation practices, not in the preservationist sense, but in the sense of helping maintain successful hunting for the future. Various goose hunting practices fall into this category; for example, prohibitions against shooting into main flocks (which

would scare away the rest of the geese) and against hunting on calm days or after sunset or on Sundays.

An important aspect of traditional management is that individual practices, as well as the land tenure system itself, are socially regulated by mutual agreement among members of the community. Any deviation from these rules and understandings is met by social pressure as necessary. For example, a researcher living in Fort George came under social pressure in the form of repeated disapproval from the local fishermen for using a two-inch mesh gillnet, which is smaller than those normally used by the Cree and which is selective for immature cisco (Berkes 1977).

The Trapline System

The key institution that regulates the use of wildlife resources in the James Bay area is the trapline system. As recognized by the government, a trapline is a registered beaver trapping area in which a native tallyman has harvesting rights. As seen by the Cree people, a trapline is a traditional family hunting-trapping territory. Accordingly, any violations are dealt with by social pressures rather than by recourse to white man's law, and there are remarkably few such conflicts as long as traplines are not easily accessible. Only those people who are family members of the tallyman or who have been given permission by him can trap beaver on a trapline. Other people passing through the area can take animals which they encounter; by mutual agreement there is no permission requirement for such people, they can harvest animals, especially fish and small game, for their immediate food needs.

This situation holds true for non-natives as well. For example, Fort Rupert tallymen argued that non-natives, travelling overland by canoe, should be able to fish for their needs, even if their take exceeds the provincial daily bag limits for the various species (Berkes, field notes). However, they were very critical of fly-in fishermen, and thought that the regulations that applied to them were too liberal (Berkes 1978).

Biologically, the trapline system is good management. Clarke (1980) writes, ". . . the most conspicuously successful policy in the whole wildlife area anywhere in the world was developed here in Canada; I refer to trapline management, also known as fur management. It was the brainchild of Frank Butler in British Columbia, developed more than 50 years ago . . . When you look at it, Frank Butler's idea could not possibly have been simpler. All that was necessary was to devise a system whereby trappers could reap the benefit of their own restraint. It appealed especially to native peoples, as it conformed to their philosophy and practices."

According to Bouchard and Lepage (1980), "the setting up of this system seemed to the natives to be a gesture of recognition of their special hunting, fishing and trapping rights and the need to maintain and preserve their traditional activities on their ancestral lands." On the *origin* of hunting territories in the eastern subarctic, however, there is a long controversy in the literature of anthropology. Most anthropologists hold the view that the hunting territory system was not aboriginal but developed with the fur trade. This may have been so, but it does not detract from the fact that the use of territories for the management of beaver, which is a productive predictable resource, makes eminently good sense from the point of view of optimal foraging strategies in ecology. With regard to the controversy, it is interesting that geese are also hunted on a territorial basis. Goose hunting

territories, found only on the coast from Eastmain to Fort George, inclusive, are in many ways similar to the beaver trapline system, but are not government-sanctioned, nor, for that matter, enforced by any means other than customary law (Berkes, in prep.).

Which species, other than beaver, fall under the control of the tallymen? The Cree do not normally discuss hunting territories in terms of individual species, but rather in terms of *access* to an area in which particular kinds of hunting methods can be used. For example, moose have relatively small home ranges and predictable winter yarding areas. A good knowledge of a particular area of moose behaviour under different conditions of wind, temperature and snow conditions, makes the outcome of a moose hunt relatively predictable (Feit 1973). Moose are not usually killed in chance encounters but in well planned hunts. However, well planned hunts can only be executed by people who know the area intimately and who have access to it. Therefore, even though there are no defended moose hunting territories as such, the role of the tallyman in providing access to an area assures that moose are, in effect, hunted on a territorial basis. This is accomplished by *design*, rather than by explicit regulation, written or otherwise.

The workability of this land tenure system is helped by the fact that hunting and fishing are normally done on a subsistence basis. Furs are, of course, sold for cash, but it would be unthinkable to a Cree trapper to catch so many beaver that the meat would be wasted. A cultural code of ethics strongly prohibits the wastage of beaver meat. (This is not the case, for example, for ringed seal which is also a commercial species, but for the Cree, a relatively minor one.)

Even though the Cree have been Christians for several generations, pre-Christian religious practices and rituals, such as showing "respect" for the beaver by returning the bones to the water, guard against the misuse of the resource. As Feit (1973) states it, hunters have several responsibilities to observe, and transgressions of these responsibilities bring "bad luck", in the form of a long period of poor hunting success, as opposed to a short period of poor hunting success which may simply be due to the "whims of the animal". Similarly, Martin (1978: 73) argues that the Indians' concept of "balance of nature" was a notion of mutual obligation between the hunter and the animals. As long as the hunter fulfilled his obligations, the animals would make themselves available; catastrophe resulted, however, when a party broke contract (see also Tanner 1979).

For most living resources, which have no cash value, the magnitude of the harvest is simply keyed to needs. It has been shown for Fort George subsistence fisheries, for example, that the harvest of a fisherman is closely tied to the food requirements of his family (Berkes 1977). Even though the marginal effort in setting and checking an extra gillnet was relatively small, this was not done until the catch per unit of effort fell below a certain level. The fishermen set just enough nets to give them a catch that fulfilled their needs, which in the case of one family in the study, was about 10 kg per day. This harvest was obtained, on the average, with two nets in spring and fall and four nets in summer. There was no incentive to create a surplus (except seasonally for smoking and freezing) because a fisherman would simply end up giving away the excess catch (Berkes 1977).

Thus, a *self-limiting principle* is in operation in subsistence harvesting. This acts as a negative feedback loop: increasing levels of harvest decreases the incentive for further hunting and fishing effort. According to the Cree, a good hunter is someone who is consistently able to harvest what he needs, not necessarily someone who harvests a great deal. The Cree disapprove of killing animals to build a reputation or for self-aggrandizement (Feit 1978).

Conditions for the Breakdown of Traditional Management

The land tenure system and these various ethical-cultural practices effectively constitute management by design. However, the analysis also suggests that management would break down if design criteria have been violated. Customary laws are mutually agreed upon by the whole community and remain viable as long as they are socially supported. If conditions change so that the ground rules no longer make sense, customary laws dealing with animal resources collapse. It is important to know if they are then irretrievably lost or not, and in respect to this question there are some pertinent historical data.

In the case of beaver resources in the James Bay area, there are two and possibly three cycles of drastic declines followed by recovery. In the case of the earlier cycle(s) there is good evidence that the decline(s) correspond to periods of intense competition between fur trading companies (Clarke 1973; Feit 1978). The most recent cycle occurred in this century. The advent of non-native trappers in the James Bay area in the 1920's, maximizing their short-term returns and no doubt ignoring the system of native land tenure, is closely correlated with the breakdown of native traditional management and the near-disappearance of beaver.

Just as the Plains Indians are said to have contributed to the demise of the last buffalo herds, the James Bay Cree probably contributed to the depletion of the beaver. Some speculative and unlikely theories have been advanced to explain these events, such as Martin's (1978) regarding a deliberate war that the Indians waged on the beaver. However, subsequent developments lend support to the hypothesis advanced in this paper, that events are fully explainable in terms of the breakdown of customary law and the land tenure system. Once the system was restored in the 1930's by government law, closed-access conditions were re-established. The beaver recovered in the 1940's and the 1950's under a government system reinforcing traditional law and prohibiting non-native trapping in the area.

The decline of caribou in the Labrador-Ungava-Hudson Bay area at the turn of the century provides another example of the breakdown of customary laws dealing with hunting. In this case, there are no hunting territories involved: caribou are not hunted on a territorial basis, presumably because they are mobile and not a defensible resource, and in addition, there are no effective hunting or trapping territories north of 55° N in this area.

Based on historical records, Elton (1942: 378) notes that caribou diminished suddenly after 1904, perhaps due to over-hunting following the introduction of the repeating rifle. Elton (1942: 372) cites from missionary accounts on the Labrador coast: "many of our people looked upon the lack of reindeer herds in the year under review (1905-06) as a just punishment for the indiscriminate slaughter of the animals on the part of some of their number during the previous year."

It appears the power of the repeating rifle gave a false sense of security to some of the hunters: they no longer had to observe their obligations towards the caribou, as they could now kill rapidly and from a distance, without having to wait for the animals to cooperate. Martin 1978: 16) forwards a similar argument regarding the beaver overkill, as partly a function of the effective new technology of steel trap and castoreum which gave the natives a short-lived euphoria of power.

Although many contemporary authors accept Elton' evidence that the introduction of modern firearms was a major factor in the decline of Labrador-Ungava caribou, Banfield

and Tener (1958) also point out that there probably were other causes. In particular, they point out the effect of great fires and the destruction of the winter range, especially on the Hudson Bay coast. Other factors, such as the effect of the whalers at the turn of the century and their demand for caribou, have not been systematically studied.

The commercialization of a subsistence hunt is probably one of the better documented mechanisms by which resources come to be overharvested. Incentive to create surplus breaks down the self-limiting principle of a subsistence operation, and together with it, the customary laws that regulate hunter-prey relations. From experience in various parts of the world, including the Pacific (Johannes 1978) and Caribbean (Nietschmann 1972), there is little doubt that commercialization of subsistence fisheries often results in overfishing. In the James Bay and northern Quebec area, the development of government-sponsored and native-run commercial fisheries has been causally related to overfishing in several parts of the area (Berkes, this volume). Commercialization of caribou hunting to serve the needs of over-wintering whalers at the turn of the century and commercialization of musk-ox hunting have been linked to the near-disappearance of various populations (Clarke 1973). The more recent developments of an Asian market demand for ungulate antlers may be viewed with alarm from this point of view.

Increase in the population of hunters, in the long run has much the same effect, by increasing the demand for the subsistence product, and also simultaneously exerting stress on the land tenure system to accommodate an increased number of hunters. There was a population explosion among the Cree, following sedentarization in the 1960's, similar to the experience elsewhere following the permanent settlement of nomadic populations.

In the Fort George area the number of potential goose hunters greatly increased, forcing the existing goose hunting sites to accommodate more people, and encouraging the use of marginal or risky sites (risky from the point of view of scaring away the large flocks). One symptom of the stress was the appearance of some young hunters with little respect for the goose territory system, who sometimes spoiled the hunt for others as well by not following good hunting practices as prescribed by customary law (Berkes n.d.). In the inland areas inhabited by the Cree, a symptom of the stress was the intensified use of hunting territories. Instead of "rotating" hunting areas (similar to fallowing in agriculture) to allow game populations to recover as customary law would prescribe, hunters started to use some territories year after year, with declining rates of return (Feit 1978). As well, in some areas this process was accompanied by a fragmentation of hunting/trapping territories. For example, in the Waswanipi area 39 traplines in 1967 became 50 traplines in 1977 (SOTRAC 1978).

All of these stresses were operative prior to the James Bay hydro-electric development and the James Bay Agreement. With the hydro project, one additional and obvious stress was the flooding of major parts of several Fort George traplines. Somewhat more subtle, the change in access patterns throughout the development area caused additional stresses to the native land tenure system. Until 1971/72, there was no road access north of Matagami and Chibougamau (about 50° N). Soon after the hydro project was announced, two main trunk roads were built, one due north from Matagami to the LG-2 dam, and the other on an east-west axis, connecting the main construction areas along the LaGrande River. Various side roads were built, and the trunk roads were extended to reach Caniapiscau in the east (1979/80) and Poste-de-la-Baleine in the north (mid-1980's).

Thus, by the early 1980's, much of the area to about 54° N was opened up by road access. Some of the Cree communities, including Fort George, were connected to the road network. The Cree did not oppose the roads. In fact many welcomed them, although probably the majority had mixed feelings. Tallymen, especially those of distant and little used traplines in the LG-3/LG-4 areas, welcomed the roads because their lands could now be reached by truck, rather than by expensive bush plane charter. (Overland travel, many weeks by canoe and portage, to these far traplines was discontinued in the 1960's following sedentarization.)

However, the problem for the land tenure system was that these lands also became accessible to anyone. Areas along roads rapidly reverted to a common property resource status. Privileged information was no longer necessary for access, and even the beaver resource could no longer be defended. People travelled up and down the roads by truck, noting areas likely to be good for fishing or muskrat trapping. Beaver were depleted along the Fort George to LG-2 road in three or four years, and even small game became hard to obtain. By the late 1970's, fishing and hunting were carried out further afield along the roads, to the south and east of LG-2.

Controversies over hunting rights reached some degree of stability after a few years. The new consensus was that anyone could hunt along the roads, but the position of the Cree Trappers Association local (an organization made up of tallymen) was that such rights would exclude beaver trapping. Thus, customary law had been re-defined to allow hunting in non-traditional areas, even muskrat trapping, as long as beaver rights of the tallymen were respected. Similar re-definitions of native customary law may be found in other communities which have experience with new road networks. For example, parts of the Waswanipi area is criss-crossed with forestry roads, and trappers occasionally encounter traps set by people unknown to them. A tallyman cited the appropriate customary law thus: "The first time I see somebody else's trap on my land, I pull it out and hang it from the branch of a tree. The next time I see it, I take it away."

In summary, it can be readily seen that the native land tenure system is fragile. It can be perturbed by (a) loss of control over resources and the creation of open-access, common-property conditions, including the effect of the change in road access patterns, (b) rapid technological change, (c) commercialization of subsistence uses of a resource, and (d) rapid population growth.

Historical and current experience show that the effects of these perturbations are not necessarily permanent. In some cases, where the root cause of the perturbation is dealt with (as in the case of beaver in the 1930's) customary law becomes operative once again and the system recovers. In other cases (example of the roads) there may be a permanent change; the ground rules are re-defined and the system adapts to change. The adaptations may not come about smoothly or rapidly; there may be considerable social disruption, which may contribute to poor conservation practices, during the period of adjustment.

The material presented here perhaps also explains why the native people insist that the control of land is critically important. The land is important not because it is a piece of real estate, but because it supports living resources that provide sustenance. To paraphrase Clarke, hunters need to be able to reap the benefit of their own restraint if the resources are to be conserved; this is possible only when there is control of land. The argument also shows, from the native point of view, the inadequacy of the present trapline system. To quote from Bouchard and Lepage (1980: 26):

> In practice., however, the native peoples saw that the system protected them only against competition with non-native trappers but did not give them any guarantee concerning hunting and fishing in general. This system in fact did not prevent the establishment of outfitters or private fish and game clubs with or without exclusive privileges. Nor did it provide any protection against competitive activities likely to affect, directly or indirectly, the trapping activities and the way of life of the natives, for example, pulp and timber cutting, mining operations, the harnessing of water power . . .

It is perhaps appropriate here to point out that no argument is developed in this paper that native peoples are, by nature, conservers. Nor is it argued that native peoples are predisposed to destroying their resource base. Rather, the point is made that good resource use practices develop over time among peoples who are dependent on a particular resource. Despite various perturbations, the persistence of such resource use practices have been extensively documented for some James Bay area fisheries (Berkes 1977) and for moose and beaver harvesting (Feit 1973).

Appropriate Management Approaches, By Animal Group

The animal resources utilized in the James Bay area may be for convenience grouped into six, as has been done in the James Bay and Northern Quebec Native Harvesting Research Study. (1) Big game (moose, caribou, black bear), (2) waterfowl (geese, ducks, loons), (3) fish, (4) fur animals (beaver, muskrat, otter and others), (5) small game (snowshoe hare, ptarmigan, grouse and others), and (6) marine mammals (mainly ringed seal).

Of these groups of animals, only the fur-bearers are presently managed completely by internal regulation; most fur-bearers ars predictable in terms of location and are harvested seasonally. The trapline system was established by the government with this group of animals in mind, and despite the problems detailed in the previous section, management continues to be workable. If the hydro development project results in the flooding of many more trapline areas however, a trapline reorganization will be necessary. The James Bay Agreement has provisions for this eventuality, and some background work has been done under the remedial measures program (SOTRAC 1978); however, no reorganization had yet occurred as of the early 1980's.

Small mammals as a group mainly consist of species with periodic population fluctuations. It is generally considered that species such as snowshoe hare and ptarmigan are beyond management because of these fluctuations, and there are no attempts by the government to control harvests. Similarly, no attempt is made to regulate the harvest of the main marine mammal species, the ringed seal, which is found abundantly but in scattered populations. Polar bears do present a major management problem in much of the North, but the Cree catch is limited to an occasional kill (and therefore the main problem is outside the scope of this paper).

The remaining three groups of animals (waterfowl, big game and fish) all include populations which are sought after by both the Natives and the non-natives. The rest of the discussion in this paper will therefore focus on some members of these groups which cannot be managed by internal regulation only.

The per capita waterfowl harvest by the Cree is very high in comparison to non-native hunters. It has been argued elsewhere (Berkes n.d) that the per capita Cree harvests of

geese have always been high as far back as historical records go. However, recent trends show a relatively constant total harvest and a declining per capita harvest despite increasing hunting effort. The reasons for this appear to be the limitation of the number of suitable hunting sites during the relatively brief periods when the geese are available. Unrestricted and haphazard hunting is prevented by the goose territory system and conventional laws that specify how hunting should be carried out. If this system breaks down, short-term damage can be done to the resource, but this would be followed by the much more rapid passage of the geese in subsequent seasons and a consequent drop in the total harvest.

The James Bay Agreement embodies management principles that take account of the unique problems of waterfowl management. The Cree have legal rights to a harvest allocation based on a percentage of the various populations; this percentage is to be established on the basis of the levels of harvest during a specified period (1974-79). While in principle the management mechanism is sound, problems in implementation have already been encountered with respect to the Atlantic brant, which declined to very low levels in 1977-78, but subsequently tripled in numbers by 1980, despite a continuing Cree hunt (Berkes n.d). The major problem in brant management appeared to be related to the necessarily slow management response, and even slower communication of biological concern to the native hunters.

Big game management problems are centered on moose in the James Bay area and on caribou in northern Quebec and Labrador. Moose are a predictable resource and usually harvested on a territorial basis, as explained earlier. However, in the Quebec big game management zone K3 which corresponds to the southern part of the James Bay territory, non-native hunters take about as many moose as do the Cree, and conditions approximate common property resource use. There is a possible over-hunting situation in K3; elsewhere in the area where the non-native kill is relatively small, there is no evidence of over-hunting. There are allocation policies in the James Bay Agreement for big game, but the means for implementation have not been made specific.

With regard to caribou, the western James Bay area is not open to non-native hunters (as of the 1981/82 regulations). Even though caribou are mobile and not a resource suitable for management on a trapline basis, the relatively constant numbers obtained by the Cree suggest that some form of self-regulation may be in operation (but as yet unstudied). For example, the Cree of Fort Rupert have reported harvests averaging 51 caribou per year (range 29 to 80) between 1972/73 and 1978/79 with no increasing or decreasing trends. The harvest seems to come from an area within Category II lands which constitute the exclusive hunting area of this group of Cree people. The herd, if there is one, is unknown to biologists and no concentrations of caribou have been spotted in aerial surveys in recent years anywhere in the Fort Rupert area. There are enough hunters and enough guns in Fort Rupert that a relatively small group of caribou could be killed off very easily. Yet this is not happening — despite the absence of closed seasons, bag limits or hunting permits.

Some of the non-game fish resources, such as whitefish, are legally restricted for native harvesting only. However, controversies have developed over several species sought after by both user-groups: in the James Bay area, these are brook trout (brook charr), lake trout (lake charr), pike and walleye (Berkes, this volume). The Quebec government has encouraged the non-native harvest of brook trout by setting regulations which are more liberal in the James Bay territory than elsewhere in Quebec. This despite the fact that, according to biological principles, bag limits should be smaller and fishing seasons shorter

in the North than in the south (Berkes 1978). There are Cree complaints over local overexploitation of the brook trout by fly-in fishermen from the south; there is little enforcement of even the present liberal regulations. The problem is the familiar common property problem: since brook trout runs are highly localized and predictable, and since there are only a limited number of good brook trout areas, the native fishermen have little incentive to restrain themselves for if they do not harvest the trout, someone else will.

In summary, the main management problems concern a relatively small number of species (moose, geese and some fish such as brook trout) over which the Cree are competing with the non-natives. Neither the trapline system, nor (in recent experience) the James Bay Agreement fully protects native legal rights due to problems in enforcement. Further, the area reserved for the exclusive wildlife use of the native populations is being continuously eroded by hydroelectric development and increased access. This is the situation from the native point of view.

The opposing viewpoint is that the native people should have no preferential rights to wildlife resources. There is an increasingly vocal expression in Quebec of the view that native hunting rights in general are not justifiable; more specifically, native peoples of James Bay and northern Quebec have somehow acquired control over the best hunting and fishing areas (see Bouchard and Lepage 1980). The magnitude of native harvests of such species as moose and Canada goose have triggered strong reactions from hunting associations, sport writers and some professional biologists. As such, these criticisms of native harvests in Quebec differ little from similar criticisms in Ontario and other provinces and territories.

Some of the critics hold the view that subsistence harvests should be carried out using traditional (pre-contact) methods and equipment, and that insisting on traditional hunting rights while living a modern lifestyle is using a double standard. Others hold the view that a distinction should be made between Natives who depend entirely on harvesting (and who should be allowed a "sufficient" but controlled harvest) and those who are wage-earners (and should be subject to the same laws as non-natives).

The points of view of the native peoples and those of their critics can probably never be fully reconciled. But the attempt here is to devise an integrated management system that takes account of the realities of self-regulation and regulation from the outside in light of material reviewed in this paper.

Discussion

William Ophuls (1977: 228) defines *design* as "the attempt to produce the outcome by establishing criteria to govern the operations of the process so that the desired result will occur more or less automatically without further human intervention." The concept of design is not new; it has been associated, for example, with the work of Ivan Illich. In the case of living resources management, design may be contrasted with *regulation*, which refers to the attempt to produce the desired outcome (conservation) by establishing and policing such rules as closed seasons, bag and possession limits, closed areas, license limitation and quotas for the various species to be conserved.

The Cree land tenure system, with the trapline institution and the cultural complex that regulates man-animal regulations, may be considered management by design. This is not

management in the biological sense, but rather management in the sense that the resource continues to be productive, as in the example of the Fort Rupert caribou. The important quesiton is whether management by design would continue to work, given that there are the inevitable technological changes, population increases, and factors (such as roads) which help create open-access, common-property conditions.

For many native spokesmen, the solution lies in the complete native control of land and resources. Management will take place by customary law or whatever term that may be used in reference to the common principles of self-regulation.

The problem with this approach is that many resources are of interest to other user-groups as well. In the case of James Bay, examples are the moose, geese and brook trout. Elsewhere in the North, examples may include many of the caribou populations and many populations of migratory fish such as salmon. Where the species cross jurisdictional boundaries the problems are even worse: examples include the Kaminuriak caribou, Pacific and Atlantic coast salmon. Thus the management approach has to proceed with allocations; within the area where native hunters operate, this need not contradict native practices and institutions, as in the James Bay Cree goose hunt. However, the involvement of other user-groups in the management process is also necessary to achieve consensus, so that the allocations make sense to all users.

Yet, as in the case of James Bay, provincial and federal governments retain full jurisdiction over resource management, not only to mediate allocations by user-groups, but also to intervene if necessitated by conservation considerations.

For many critics of unrestricted native hunting, the solution lies in enforcing some regulations on the group in question, under the assumption that whatever balances operated in historical times between the hunter and the hunted are no longer operative.

While such a long-term view of population and resources is necessary for the planning of northern wildlife policies, the proposed solution would not be workable. On the one hand, assuming that whatever ecological balances that existed are indeed completely lost, it is rather improbable, in view of increasing populations and acculturation, that those balances will come back in the future. On the other hand, assuming that lost balances can only be replaced with white man's hunting regulations, implies that such regulations are enforceable. The nature of hunting activities in the North, with many hunting camps scattered over a very large area, makes it nearly impossible to enforce such regulations as bag limits. One need only consider, for example, the fact that governments have never been able or willing to enforce in the North the ban on spring hunting of waterfowl, as provided by the Migratory Birds Convention Act.

Given that the application of a pure self-regulation approach, or a pure "regulation from the outside" approach for all wildlife groups is impossible or nearly so, a more flexible approach involving some combination of the two, by different animal groups, is therefore necessary. It may be the only reasonable alternative for all concerned with the long-term conservation of fish and wildlife. First, this approach would recognize that native hunters/fishermen/trappers have practices which have developed over a long period and which are ecologically adaptive, keeping in mind that these practices may be under considerable stress at a given point in time.

Second, this approach would recognize that in nature animal populations are never in perfect balance, that systems are ecologically resilient, and that adaptation is a continuous

process. This requires the extension of what is normally accepted in biological ecology to human ecology, and may be difficult to accept for those who have a pessimistic and deterministic view of man-environment relationships. The assumption of inevitable decline of wildlife because of the open-access, common-property nature of the resource is simply not tenable. As in the case of James Bay, often there is social regulation of access; the resource is communally shared under mutually agreed rules, not merely viewed as common property.

A management approach that recognizes existing design criteria and local self-control, where they exist, and gives native management institutions the support of written law, is wise management. It is a symptom of the lack of such wisdom that wildlife populations become the major losers in a "war" to assert sovereignty over local/regional land and the living resources it supports.

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GATHERING AND GOVERNING: Renewable Resources and the Economy of the North

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Points of Departure for Policy Formulation

"Economy", deriving from a Greek word, originally meant "house management"; and the concept of the "the economy of the north" is not nearly as free of its original meanings as we sometimes assume. In fact, our attention is all too easily concentrated on the somewhat antique economic virtues of industry and thrift, to the exclusion of much else; and discussion about the economy of the north and the management of its renewable resources usually moves quite quickly to the advantages of orderly conduct and the production and distribution of material wealth. The Latin word "dispensatio" was one translation of the Greek "oekonomia"; and the ideal of wise dispensation, or responsible stewardship, has also been central to the idea of an economy, and now essentially directs our notion of renewable resources. Of course, both concepts can be translated into concrete instances, and thereby in a sense purged of this sort of abstraction; but that kind of empiricism provides only part of the story. Both "renewable resources" and "the economy of the north", as concepts, are informed by theoretical premises which, willy nilly, affect any transformation of the concepts into realities. So it is with these premises and their implications that policy consideration should start. Unless policy consideration starts there, I suggest it will neither get very far, nor help very much in the definition and resolution of the issues which pertain in the north at present. We are perhaps a little more aware than we used to be that the economy of the north involves the management of a house which is a homeland to many, and a frontier to others. But we are not as aware as we might be that the homeland habits of harvesting fish, fur and game stocks, though they certainly nourish body and soul in significant and indispensable ways, may finally be less essential than the sense of belonging to, and drawing life and meaning from, the native group or nation. And although this is not a notion which is easily compatible with the kind of analysis we are inclined to apply to renewable resources and the economy of the north, it may be time we modified our analyses, and considered some new approaches to the issues.

Broadening Approaches and Definitions

We always tend to think of the opposite of "wealth" as poverty, which we rightly deplore. I have always admired John Ruskin's suggestion that the opposite of a humanely conceived idea of wealth is really something more like "illth", a word he coined. In one way or another, we do think a lot about wealth (and its opposite), often within a fairly narrow perspective; as, for example, the ideal of a commonwealth, losing its sense of a common-weal, becomes that of a common market. I would propose that it is time to consider the possibilities of a somewhat broader notion of the north, of its renewable resources and its economy, of its wealth and its illth. Ruskin had another notion, which may help: that any worthwhile enterprise involves the two basic functions of gathering and of governing. In the case of the north, the first would imply an informed and intelligent planning process,

gathering together the information and the individuals necessary to make wise decisions; while the second would require an imaginative and effectively diversified pattern of control, in order to govern the development of the north in a balanced and responsible manner.

Challenging False Alternatives

I am not pretending that one can survive in the north on etymologies, or prevail by being clever about economic history. But Canada, like the United States, continues to show itself unwilling to abide enclaves of significant economic or political variation; unwilling to temper the relentless prerogatives of an agricultural or industrial economy with the priorities of, say, a subsistence economy uninterested in the accumulation of capital or the division of property; and unwilling to accommodate a collective autonomy within its structures of liberal individualism. It is time, and this is a good time, to challenge this unwillingness; just as it has long been time to challenge the silly alternatives of separation or assimilation, which certainly conditioned nineteenth and early twentieth century policies affecting native people, and which represent false choices, both inappropriate and unnecessary, and ultimately pernicious. It need not, indeed it must not, be a matter of choosing between being drowned or being marooned on an island, but a matter of choosing which of several ways to take advantage of living by the shore, with access both to the land and to the sea. The point here is not simply to pose dewy-eyed challenges, of course, but to propose new approaches with specific reference to the subject under discussion. And I suggest that it may be useful to consider the interrelationships between the functions of resource planning and the elements of resource control in a way that emphasizes both the intrinsic limitations of planning and power alone, and at the same time focusses on the possibilities for cancelling out these limitations by devising a union of the functions of planning and the instruments of control in which the whole enterprise is not only greater than, but different from, the sum of its parts. Planning can proceed in a new context, with more complete information, with fuller participation, and with a more comprehensive sense of the constituent parts to which its attention is directed; and control can be diversified both as to parties and as to instruments, so that for example proprietary permissions may provide one sort of control to one group, regulatory functions afford a comparable authority to another, and political (including economic) power give leverage to yet another group, the groups themselves being defined according to native as well as non-native prerogatives. This is where attention needs to be paid, I think.

Planning and Control: Twin Elements of Resources Policy

The only fully responsible way to consider renewable resources and the economy of the north is with reference to both the instruments of control and the constituents of planning. So much is, in a way, generally accepted. The Berger report, for instance, neatly divided between recommendations dependent upon the priorities of planning (avoiding the northern Yukon) and recommendations dependent upon the prerogatives of control (allowing ten years for the settlement of land claims). The Expanded Pipeline Guidelines (1972), with their premise of comprehensive planning and their concern for cumulative impact, reinforced one set of recommendations; while Canada's North 1970-1980 (1972), the government's northern policy statement, with its regard for the preferences and aspirations of the people of the north, and its affirmation that "the needs of the people in the north are more important than (non-renewable) resource development", supported the other. What is not so generally accepted is the need to mitigate the disadvantages of any particular model of planning with the advantages of a different model of control, and vice

versa. If there is insufficient information to plan with the right sort of imperial omniscience — and there never is enough information — then it may be necessary to diversify the instruments of authority in a way that provides for the exercise of enlightened (even if not fully informed) self-interest as a balance against the limitations of the planning process.

There are several basic components identified below, which might benefit from further consideration and discussion.

Definition of the Interests

The interests pertaining to renewable resources and the economy of the north are diverse, and include what I would call the native interests, the northern interests, and the national interests. There is significant overlap, but their priorities are different (and of course vary from time to time), and their powers (such as they are) function by different means, and to distinct and sometims opposing ends.

Definition of the Issues

The facts and fictions which sustain particular approaches to renewable resources and the economy of the north are subject to modification, and often to fundamental change. There is always a need for more research to provide more facts, and for more analysis to transform these facts into usable fictions, or theories. Research and analysis are continually necessary, and it is continually necessary to be sceptical about their conclusions. This is no news to any responsible scientist, and responsible scientific assessment of the issues takes account of this. What is not so readily taken into account is the need for decision-making structures which provide a balance to the fallibility of information and interpretation (inasmuch as this informs the planning process), and which allows for the definition of the issues in terms appropriate to the awkward prerogatives of regional control as well as to the tidier priorities of planning.

Addressing the Issues

The premises upon which both the interests and the information relating to renewable resources and the economy of the north are considered have generally been established in a way that is primarily reactive, not to say reactionary. This applies as much to governments as to interest groups. For example, land use planning has all too often been little more than a series of responses to (often inevitably conflicting) demands for land. Or, looking at it another way, patterns of hunting and gathering have too seldom been used to establish extensive rather than intensive use of the land as the basis for a northern economy. Pipelines and mines and hydro-electric projects would still have a place; but the elements of planning and the instruments of control would differ — and the overall thinking about the issues would be distinctly different — as the premises changed. If the premise is that the north has the characteristics of an under-developed country, then even the apparently impeccable ambition to achieve balanced development is skewed to reinforce patterns of control that enhance the centralized authority of governments, and planning recommendations that favour the creation of employment and income opportunities within a framework of industrial activity. These are not necessarily bad ideas, but they do tend to work against any tolerance for those enclaves of significant social, economic or political variation in the country, and especially in the north, to which I referred. The result is the creation of marginal groups, whose marginality becomes part

of the complex economic and social planning problems instead of a component of newly diversified patterns of control in which marginality does not exist as a limiting category.

The Complementary Functions of Comprehensive Planning and Diversified Control

Planning assumptions as well as planning information will always be fallible, and must be flexible. But there is a strong tendency to consider local socio-economic concerns as providing the flexibility, and large-scale industrial prerogatives as providing the opportunities. This may be an inevitable attitude in that large-scale projects tend to take on a life of their own. Since it is also inevitable that all the information is never available when needed, it follows that when a great deal of neatly packaged information does appear at one time it compels attention in a special way. It is therefore crucially important to provide for a broadly based and diversified pattern of control to balance not only the compelling logic of impact assessments related to large projects, but also what may in the future be the equally relentless and purposeful planning mechanisms that will pertain to renewable resources and the economy of the north. The point of this would be to ensure a pattern of control that lets compromises be made — regarding land use activities, say — by those who will, as it were, be compromised by those activities. Integrating the functions of comprehensive planning and diversified control, of gathering and governing, will not be easy, but it is necessary. It should be the responsibility of this symposium to address some of these issues, not independently — we become too adept at that — but interdependently.

THE CANADIAN HIGH NORTH
Resource of Renewal

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Climbing the Mountain

In one of his famous stories, Ernest Thompson Seton (1902) tells of an Indian village beside a high mountain towering up in the desert. One day the Chief of the village challenged the youngsters to climb the mountain. "Start early in the morning and go each of you as far as you can. Then, when you are tired, come back, but let each one bring me a twig from the place where he turned."

Away they went, each full of hope that he surely would be the one who would reach the top. But soon one returned trudging slowly back and in his hand he held a sprig of cactus. The chief smiled and said: "My boy, you did not reach the foot of the moutain; you did not even get across the desert." Later a second boy returned with a twig of sagebrush. The next had a cottonwood spray. Another came with some buckthorn. To each of them the Chief unerringly stated how far they had gone.

The sun was low when the last returned. His hands were empty as he approached the Chief, but his face was radiant: "My father, there were no trees where I got to. I found no twigs, but I saw the Shining Sea." Now the old man's face glowed too, as he almost sang: "I knew it! When I looked at your face, I knew it. You had been to the top. You needed no twigs for token. It was written in your eyes, and rang in your voice. My son, you have felt the uplift, you have seen the glory of the mountain."

Colleagues and friends on our Northern Trail, assembled here under these majestic peaks, we are challenged with a task identical to that of the story and yet one as diametrically different. The emphasis of the Indian chief was on climbing, on reaching the summit. We on the other hand, are encouraged not so much to climb as to search in the vast expanse of the Northern Land for things useful to collect, something to bring back which would please our chiefs in Ottawa, Washington and elsewhere — a silky fur of a silver fox, the web-like muskox qiviut or the red meat of a domesticated caribou. We are required by our villagers to bring at least baskets of red and blue berries; and dry moss and lichen, if not any more to keep the babies dry, then suitable perhaps as a fuel to keep the wigwams warm and thus help to save precious oil so badly needed for the iron horses.

It should be remembered however, that we are not the first who have been sent with such a challenge. In 1500 AD it was Sebastian Cabot who was named the "Governor of the Mysterie and Companie of the Marchants Advanturers for the Discoverie of Regions, Dominions, Islands and Places Unknowen" (Mirsky 1970).

The Hudson's Bay Co. (incorporated on the 2nd of May, 1670) form of fur trading, has constituted, in the opinion of the arctic adventurer, Lord Tweedsmuir (1978), the "most highly-tested and the smoothest running form of gentlemen's agreement ever known in the world of commerce."

And yet to all of us assembled here, it is obvious that just as with climbing high mountains, progressing further North the land produces less, and has less to offer in terms of marketable goods. Here we are at the centre of a dilemma. The northern environment is an energy deficient system. Renewability of resources on the other hand, implies an adequate energy supply. What we are asked to search for in the North are harvestable products. Something which can regenerate by regrowth or be resupplied as wind. This conference has been organized along these lines and we had agreed to attempt this task. However, we should see the limits of the system already under stress due to a variety of factors such as severity of climate, permafrost, and past and present human impact.

We are confronted with a *delicate* challenge: to point to hidden renewable resources and at the same time not to open a Pandora's box which will weaken the stability of the northern ecosystem. To achieve this, we may be in need of learning the skills of the Polar Eskimo who could virtually create something out of nothing. Nevertheless we have promised to do our best. We should rightly point to unjustly abandoned or yet unexplored projects for harnessing wind, burning peat or resin-laden heath in Northern mini-power plants, to growing southern crops "on the permafrost", or even to explore the possiblity of cultivating edible crops adapted from the native flora. Some of us would advertise reindeer and muskox ranching, farming of fur animals, and we all will discuss other attractive ideas, realistic for the present or even futuristic, on ways the North can become economically prosperous and less dependent on the south. At the same time, we are obliged to communicate to the chiefs in our governments, that complete product yielding self-sufficiency in the North is an unrealistic goal. Nature's global strategy is designed to compensate for the unfavourable exposure of the North which in terms of energy balance, year by year, is in the red. She subsidizes northern systems by shipping enormous amounts of heat via the Gulf current pipeline and by the power lines of the trade winds.

We must resist the pressure imposed on us by established opinion, shared unfortunately by many politicians, that the North is primarily of interest because of its non-renewable riches (Pimlott et al. 1976). The organizers of this symposium deserve credit for their efforts to change this popular, nevertheless, false concept of the North as a huge reservoir of oil, gas and ore for the south. There is an assortment of renewable resources available, which if intelligently utilized may last indefinitely. Northern lands are a respectable piece of world geography. Even at low productivity levels, much can be harvested utilizing modern technology guided by scientific principles.

Concept of Resources

There are three categories of resources. The "A" category serves to satisfy our needs for food, shelter, energy and luxury. These are the resources the world economists are interested in, since they help to maintain or increase the GNP of national economies. It is understood that this category is a primary target of this symposium and an number of speakers have already contributed or will contribute to this topic.

The second, "B" category includes less conventional and therefore less obvious resources: clean air, pure water, a noise-free environment and a landscape unmolested by buildings, roads, railways, etc. There can be no doubt that present world oceans are more important to man on account of their capacity to absorb and buffer quantities of toxic pollutants released by man than as a source for his food. The world's wastelands might be termed as land-based equivalents of oceans.

The area north of 60° parallel represents a significant portion of the global surface. Approximately seven per cent, i.e., 22.2 million sq km of the earth surface lies above the 60° parallel. This area is shared by 12.4 million sq km of land and 9.8 million sq km of sea. The northern lands contain a large percentage of the world freshwater reserves, of which Canada is the biggest shareholder.

The North American land area above the 60° parallel accounts for 5.4 million sq km (= 35.5 per cent of the N.A. continent area). Out of this 3.5 million sq km (or 22.3 per cent) is a treeless tundra.

The Eurasian lands cover 7 million sq km (or 21 per cent) with only 1.6 million sq km (4.8 per cent) above the treeline.

This enormous mass of land, air, water and ice, functions as a huge buffer which provides an irreplaceable cushion and sink for many physical effects, diluting toxins by means of its huge volume and locking them into the system itself.

In the 1950's and early 60's during the era of atmospheric nuclear weapons testing Strontium-90, Cesium-137 and other radioactive elements were largely deposited, fortunately for us, in less populated Northern latitudes. These elements are still there, adhered to slow growing lichens, mosses and cushion plants. They are present in the active layer, lake sediments (Svoboda and Taylor 1979) on layers of alpine and polar ice (Ambach et al. 1969). If there was no Arctic acting as a sink, the fallout densities over the populated areas of the earth would be double or triple causing serious damage to all life. The same is valid for other pollutants, mercury, lead and other heavy metals, even for acid rain, which are the present threats to the biosphere (Valentyne 1972).

These speculations are hypothetical but they do serve one purpose: they emphasize the global significance of the "extra" space, land, water and air in and above the circumpolar regions, which we tend to take for granted. The Northern wastelands are essential to our survival, directly and indirectly, and thus also to our economy. This we experience without the exportation of a cubic metre of lumber, a kilogram of fish or a single fox skin. People in Hamilton, Detroit, New York or Chicago, should be aware that every time the arctic air mass descends on their latitude, with the cooler weather there comes a shipment of fresh, clean air to their polluted cities. Thus far (although not for ever) the Arctic, like world oceans, has helped to justify the slogan: "Dilution is a solution to pollution."

Our understanding of the northern environment is still limited. Only recently have we learned to appreciate the unspoiled, undeveloped natural surroundings. So far we have appraised everything according to our material needs, often driven by unrestricted demands. Wherever we have explored, we have altered, wherever we have harvested, we have changed the producing base. Arctic organisms are "tough" in respect to their environment but are "fragile" in the face of increased impact by people (Billings 1980).

Archeologist Henry Schlieman was an unprecedented dreamer but in the light of modern science, a dilettante. It belongs to his immortal merit that he discovered and unearthed Troy, the city of Homer's sagas. At the same time his name will forever be associated with the tragedy of digging incompetently and destroying much of the archeological evidence, which would have been invaluable to contemporary archeologists. In his defence, it must be said, however, that he left a small part of the excavation site, the central column of the famous dig, intact for further, more precise stratigraphic studies.

The Canadian High Arctic is one of the last fringes of the global dig. Down south we have been turning over almost everything for millenia. During the present century, we have speeded up these efforts, by several orders of magnitude, as if we fear the end of our era in the near future (Hutchinson 1948).

Should the High North be considered more for protection than for production? There are still places with rocks in position as laid down thousands of years ago by the retreating ice. Some were split into fragments, which were subsequently shifted apart due to the action of frost and can be read as a most bizzare clock. There are outcroppings of the oldest stratigraphies through which one can almost experience the primeval environment where life had its origin.

Indeed the southern belt of the northern regions may be a provider. In its entirety, however, the North, that is the global circumpolar regions relative to our progressively expanding Homosphere, is beyond production. As the purpose and meaning of life — we must believe — is beyond its maintenance, beyond its mere sustenance.

By stating this, I feel now obliged to explain the nature of the "C" category of resources. Webster's dictionary, besides the obvious reference to "natural" resources such as oil, coal, etc. gives also this definition. A resource is "a source of strength or ability within oneself". Not only those resources which rest underground, grow and run upon the land or swim in waters, are needed by man. A resource is also a physical and moral strength, wisdom and courage to make right decisions, an ability to deal promptly and effectively with today's crisis of confusion. It seems that there is an error governing the thoughts of so many in our society: the obsession with quantity only and a diminishing respect for quality.

Mountain in the Ice

The High Arctic is the world's largest desert. Filled with "kenosis" — emptiness, the most precious resource the High North has to offer to the eternally product-hungry civilization.

In today's world, all human activity seems to be frenetic. Perhaps the High North should be allowed not to be drawn into this? Instead it should be spared and set aside as one of the last refuges that modern man has left. It could serve as an asylum of silence, of serenity and simplicity where man may search for fundamental goals, re-create and re-orient himself and return refreshed and invigorated.

When pressed and pushed by his angry countrymen, Moses retreated to Mount Sinai. He descended with a renewed mandate of his leadership and was accepted by the same rebellious countrymen. Christ withdrew to the desert before beginning his ministry. So have all hermits in all cultures. "Contemplata aliis tradere . . ." was a program of the successful medieval orders.

We all understand the meaning and the need of re-vitalizing ourselves — the usefulness of periodic seclusion. If we need to accomplish a creative, intellectually demanding work, we often "go into hiding", or at least we work behind closed doors. Larger projects which require longer periods of concentration proceed with dispatch in complete detachment from busy environments as on university campuses. Man is a sensitive creature in his mental sphere. For very special tasks in which his preoccupation with himself, his efforts to review his standing in the world, his search for achievable order, require his complete

immersion in a special environment where he can listen in silence, undisturbed by background noise. "Deserts have their own message" (Merton 1972). "People of all times were called to deserts where they could face themselves . . . What the world needs now is the power of the desert", writes Catherine Doherty (1979).

Those who have been privileged to enter this purifying realm and have been exposed to the effects of the intense radiation of the "midnight sun", will confirm that they return with burned and perhaps pealing skin but more so with an in-burned scar. If we were the boys from the candid Seaton story, no token in hand would be needed to verify our words: "Father where we went, there was nothing to collect but we have seen the Sun which never ceased to shine." "I knew it," the old Chief would say, "Now you go and sing about it to all the peoples."

It may seem as though I propose to reserve the High North for an elite club of scientists, philosophers and poets. I do not. I believe that the North should stay accessible to everybody who has the desire to venture to these serene places and benefit from the experience of the "Unusual". This, however must be done under agreed terms. Not all areas should be open to mass tourism. In Canada the Arctic Archipelago should be carefully zoned with respect to the ecological and economic importance of individual areas. Some places, such as the proposed Lake Hazen Nature Reserve at the top of Ellesmere Island (82° N), remote as it is from any civilized point in the world, should be preserved as a "Silence and Solitude" wilderness park, with very limited access. Actually, precedents do exist for the establishment of such reserves. The Nepalese Government has declared several of the Himalayan peaks untouchable. No individual or party of mountaineers will obtain permission to climb these mountains. This is for one reason only — to respect the dignity of Nature and Man, to leave Nature an unconquered frontier, even if only a symbolic one.

In recent years tourism in the North has expanded rapidly. In order to prevent the invasion of an uncontrolled tourist traffic, a plan must be evolved to direct tourists to less vulnerable areas. Here simple facilities should be established to localize the inevitable impact on the natural environment. Such an arrangement would still lead to a tourist industry which would produce revenue. It would produce also satisfaction through refreshment, recreation, recovery and inspiration to many visitors, both domestic and foreign. I wish it were the Inuit people who could take advantage of this historic opportunity and benefit from it, since well conceived and managed tourism appears to be the most promising resource of the High North, potentially providing a source of income to residents of the North in the years ahead.

On the other hand, if this opportunity is neglected, the North may face devastating Tsunami of mere profit-seeking enterprises, similar to those already operating at least in one place in the Canadian Arctic. For "merely" $3,500 a visit of less than a week is being offered to Japanese, German or American tourists to golf on the northernmost green and ice-fish in the northernmost lake of the world. Needless to say each arctic char taken from this lake can be considered a living fossil.

There is no doubt in my mind that in a short time hard-core tourist enterprises will be built in the highest Arctic, including luxurious star-war design facilities for a very special clientele, thus really making the High North accessible only to a very privileged few.

Which way to turn?

The world polar regions of which Canada possesses a significant part, exceed the national importance, in the same way as tropical rain forests exceed national importance of Brazil or Alps national importance of Switzerland and Austria. This doesn't weaken the sovereignty of these countries but rather accentuates the responsibility for preservation of their territories.

The Canadian High North includes the entire Arctic Archipelago and northern part of Keewatin on the mainland. These territories deserve a special status of protection, since their biological productivity and thus potential of regeneration is minimal. The vegetation is sporadic and consists of perennial, slow growing but long-lived plants. A *Dryas* clump only a few inches in diameter may be more than 100 years old, yet one step of a human boot may destroy it. Only after a status of protection is granted, should exemptions be made with respect to various applicants for legitimate purposes. This would allow controlled development of industrial, touristic and supporting facilities in clearly delimited areas. As could be seen, such an approach would not prevent a reasonable utilization of resources, but would correct a deeply-rooted view expressed by one high ranking official during his public lecture a few years ago: the North must be developed — because it's there!

Fortunately the Canadian North is not developed as yet. Since we are a group of people having deep insight and knowledge of the North, we also have an obligation to demand its preservation. "Most of our environmental mistakes have been made in temperate regions . . . let us not repeat this in the Arctic" (Bliss 1970). The current attempt to set aside for protection only a certain number of ecologically significant sites (Nettleship and Smith, 1975) must be considered from this perspective a well-meant but intrinsically inefficient project. Such an idea is tributary to the conservation practices on the south which deal with fragmented ecosystems. Special protection of only a limited number of northern localities would leave the rest of the High Arctic unprotected, open to traffic, exploration, and if sufficient time is allowed, to partial or complete destruction. How then would musk-ox and wolf survive, even in the preserves?

"All things are connected", wrote Chief Seathl to the "Great Chief" in Washington in 1855. "If all the beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beasts also happens to man. Whatever befalls the earth, befalls the sons of the earth."

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NORTHERN RENEWABLE RESOURCE MANAGEMENT: Socio-Psychological Dimensions of Participation

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Introduction

The paralysis which currently characterizes the management of renewable resources north of 60° is not to be understood apart from the controversy and conflict which characterizes the management of renewable, as well as non-renewable resources, in Canada in general. The opposition of northern communities to research activities, disagreement with research results and rejection of management regimes may be understood in parallel to the demand by many southern, and especially rural populations, for more direct control over their immediate environment. Both phenomenon, the stance of northern native communities relative to renewable resource management and of southern communities relative to manipulation of the physical environment, may be viewed in terms of the evolution of liberal democracy from representative democracy to participatory democracy. In the case of native northern people, especially the Inuit, we see a struggle to retain a social form of decision-making never really lost. In the south, as rural communities oppose power lines running across prime farm land, the damming and flooding of agricultural land and proposals to strip mine in rural areas, we can observe different populations variously struggling to regain a form of social organization lost in recent decades: the ability through direct participation to affect decisions with implications for personal and community form, function and well-being.

Research and Policy Problems

Problems related to renewable resource management may be viewed at two levels. On the one hand there are the problems in which research biologists, ecologists and others are typically interested. These are characteristically a concern for the approaches and methods, the data base and the transfer of this information to the policy level. There is opposition by native groups to the methods of biologists and wildlife officers, disagreement with research conclusions and rejection of resulting policies. How do we explain such responses especially when many biologists see themselves as having a commitment which they feel should be shared with native northern people?

There is another level at which problems with renewable resource management may be found. Those of us with an interest in northern issues are deeply indebted to the Canadian Arctic Resources Committee for bringing this level of concern to the forefront during the past decade. This level involves three areas of northern development and the policies which relate to each. However, a fourth area has received relatively little attention.

The first policy area involves economic perspectives with respect to the north and their relationship to, and impact upon, renewable resources. Issues of economic exploitation,

northern colonialism and economic aspects of non-renewable resource development are typically the major focus. Who benefits from northern economic development? The second policy area involves perspectives on the environment. Issues related to the preservation of our natural heritage, ecological reserves and management of renewable resources are the major focus. A third policy area involves social concerns, the relationship of native people to caribou, fish, fox and other renewable resources, particularly their importance socially and culturally. Issues related to native rights to hunt, fish and trap, and policies affecting these rights are of relevance in this policy area.

Finally, a fourth policy area of relevance to renewable resource management, and one often seen as directly relevant by research biologists and wildlife managers can be added. This area is also social, but rather than reflecting a concern with the relationship between man and environment, reflects a concern with "self", a recognition of what it is to be human and of the internal psychological and social needs of individuals and populations.

Our policies in the area of economic development appear to be national rather than regional with respect to the north, and based primarily upon non-renewable resource extraction (see, e.g. Keith et al. 1981 in respect to mining in the north). In the area of environmental preservation there has been some moderate success with the creation of National Parks and identification of IBP ecological sites and wildlife sanctuaries. Existing policies related to man-environment issues are vague. Their resolution, as appears to be the case in the James Bay Agreement, are probably left to a land claim and/or political settlement. The 1979 Baker Lake court case decision (Mahoney 1979) appears to recognize native rights to hunt, fish and trap, but does little else. Policies in these areas are all interrelated; the Baker Lake case implied that principles related to man-environment relationships shall not necessarily stand in the way of existing economic policies and interests, and that compromises which could jeopardize renewable resources and human communities are likely to be made. The sanctity of man-economic relationships as opposed to man-environment relationships is made obvious by the following, the "20th century" taken as the century of "economic man".

> Preliminary exploration has indicated that this area is rich in uranium and many other minerals and it is unthinkable that development should be stopped in order to preserve such a rudimentary way of life as to require hunting for one's next meal. Surely, we have all progressed beyond that, especially in Canada. All too often we have the southern do-gooders and environmentalists wanting to keep these people in their basic lifestyles as a sort of quaint museum-piece rather than encouraging them to become part of the 20th century (Editorial, The Northern Miner, August 16, 1979, quoted in Herchmer 1980).

Those concerned with renewable resources and the North are aware of these policy areas and issues. It is however, the fourth dimension or area for policy formulation which perhaps explains most completely the current conflicts between wildlife officials and native populations over renewable resource management. It is similarly, for native people, the most neglected area of policy concern, the only related action to date being found in the proposed Bill of Rights attached to current efforts at constitutional reform.

Participatory Democracy

In a penetrating analysis of the state of liberal democracy in the Western world, C.B. Macpherson (1977) takes note of current political and technical developments which may

make participatory democracy more possible in industrial society, replacing the representative democracy we now experience. Participatory democracy is characterized by more direct involvement, action and concern on the part of ordinary citizens, for the everyday decisions which affect their well-being. Macpherson's arguments that more participation is necessary and likely are based on three sets of observations. First, that citizens are now seeing, increasingly, the social costs associated with economic growth, an awareness which takes consumers beyond sheer passive consumer consciousness to a level of public interest and involvement. This is necessary because concerns in this area are not covered by the private interests of each consumer, or competition by political elites. Second, that there is increasing awareness of the costs of political apathy, hence the formation of citizens' groups to fight freeway expansion or the commercial development of wilderness, etc. Third, that there are major flaws in capitalism involving the production and distribution of consumer goods, inflation and unemployment and militant action or participation by labour and other groups to protect their interests (Macpherson 1977: 102-106).

The first two factors have some parallels in Inuit society. Discussions with Inuit residents in northern communities reveal an increasing awareness of the costs as well as the benefits associated with participation in the Canadian mosaic (Tester 1978). In fact, it is understandable that the Inuit would be more aware of the costs than southern Canadians, given values which are less likely to note *economic* benefits associated with development than *social and intangible* costs and benefits, and given that the significant benefits of northern development are intended for southern Canadians. Rural Canadian populations elsewhere in Canada are now starting to realize similar situations as their "frontier regions" are exploited to fuel the activities of large urban centres.

In the case of the second major factor, Inuit communities have become increasingly aware that their failure in the past to act politically resulted in events, policies and developments not in their best interests. Hence the formation of national and regional associations and other special interest groups. The action taken in bringing the Baker Lake case before the courts are further evidence of this awareness. Participatory democracy is therefore a product in Inuit society, and increasingly in Canadian society, of a changing social consciousness in response to the particularly negative by-products of our current political and economic system. In southern rural Canadian communities there are some strong parallels with native northern communities, with the latter being perhaps even more conscious of the need for participation than their southern counterparts.

Participatory Democracy and Human Needs

If it is true that ideas generated in the halls of academia find their way to public arenas several decades later, then perhaps the theories, observations and precepts advanced by humanistic psychology are also of particular relevance to an understanding of participatory democracy and renewable resource management. In his classic *Toward a Psychology of Being*, Abraham Maslow (1968) has included a chapter, "Health as Transcendence of Environment". He essentially argues that there is not only an orientation to the outer but also to the inner; that not all of man's actions in attaining psychological health are associated with adaptation to the physical environment; that we must not fall into the trap of defining our own and the mental health or orientation of others in terms of "good for" "as if he were an instrument rather than something in himself" (Maslow 1968: 179-185).

But for our purposes Maslow doesn't go far enough. Many biologists and wildlife managers feel frustrated and even "hurt" over the reception they receive from native people

because their focus is upon caribou and their use to native populations. Given that their intentions are to preserve herds and populations why would their best intentions, research and management efforts be so negatively received? The problem may be that wildlife biologists and managers have not come to grips with the *value* of game and hunting to native people. Game is seen as merely being of use. This may be described as a means-end perspective. Is it possible that caribou are more than a means to an end, that is, more than merely a means of satisfying physical and "economic" needs?

While individuals participate in hunting as individuals, it is in fact a community affair which binds people together, not only in traditional ways, but in terms of shared interests, concern for others, and with a sense of community. Value in this case then, does not refer to the nutritional value or "economic" value of game, but to its essence in terms of the beholder being human, and in this case, being Inuk.

The ultimate human need which man strives to fulfill, Maslow identifies as "self-actualization". The concept is perhaps better described in ways which can be related to native people and society. Maslow's reference is to a particular psychology and social organization which allows for spontaneity, creativity, self-expression and participation. Participation clearly necessitates going beyond "self". It is in this sense that the term is somewhat paradoxical.

It can be effectively argued that this level of humanness has been historically, and is presently, predominant in native people and society. It is evidenced in their art, their language, their writing, their relationship to film and other forms of human expression. However, it is perhaps concensus decision-making and community participation which are the forms of self-actualization most relevant to understanding present conflicts with resource managers, biologists and wildlife officials.

We are caught in what Galbraith (1978) has described as a "symbiotic technostructure" characterized by massive public and private corporations with little room for the participation characteristic of a participatory democracy. The profound rejection of these structures by native groups is perhaps related to their rejection of the renewable resource management schemes, regimes and regulations proposed by the public side of Galbraith's symbiotic technostructure. Historically and even currently, Inuit communities are characterized by a high degree of concensus and participation in decision-making (Tester 1981), a characteristic which may reasonably be associated with a society that is highly self-actualizing.

Conflict also has a role to play and is relevant to understanding native opposition to management policies. It is well known that the cohesion which characterized Inuit society has been threatened by industrial society. There are gaps between generations which are more than a function of age. They are present because of changing values and a resultant discontinuity of values across generations, internally parallel to the differences in values which exist between cultures. Other stress-creating forces are also present: the presence of different and relatively new religious perspectives further impact internal cohesion, and issues associated with modern industrialization, such as the use of alcohol, further divide Inuit communities. In the face of potential for internal division, conflict with the dominant culture serves a socially useful purpose. It is the presence of external factors, be they wildlife biologists, researchers or legislators, about which general agreement can be found and toward which social energy, which would otherwise be released in internally destructive ways, can be directed. There is therefore, around issues of renewable resource

management so central to native northern cultures, considerable conflict with outside "forces" which serves to maintain internal cohesion and which helps prevent social disintegration (e.g. see Coser 1956: 33-38). One can speculate that the removal of such common points of conflict may not be in the best interests of Inuit or Dene society, unless associated simultaneously with other forms of social action and response to the conditions of contemporary native society.

It was suggested by Peter Usher, in his address to the Symposium (reported in this volume) that caribou and other renewable resources had become somewhat of a football in a game where research results and methods are opposed because they lead to regulation that is imposed from without. With this observation I clearly agree. My comments on self-actualization and native society are intended to elaborate on this point. The opposition to regulation not established locally is a function not only of the violation of culture and tradition but, as growing evidence from southern and especially rural communities would suggest, of a violation of higher-level human needs. These needs become the focus of more attention in a society which has met basic survival needs.

It is also the case that when confronted with competing goals which relate to our personal and collective needs, we make choices and establish priorities. Our choices relate to the preservation of the most important and central aspects of our humanness. While Inuit and Dene societies could choose to accept the data and regulations related to renewable resources, and while the imposed regulations might result in the preservation of species, to do so would be to sacrifice the concensus, participation and capacity for self-actualization which perhaps are of even greater significance to the Inuit than caribou and hunting itself. Hunting is perhaps the vehicle by which such individual and collective attributes are operationalized. Hunting in a cultural milieu which no longer includes the sharing, concensus and participation characteristic of Inuit culture is not a meaningful activity.

It is these abstract qualities which lie at the heart of Inuit society, and not as commonly expressed, the act of hunting and trapping itself. Hunting and trapping are expressions of these characteristics, more readily verbalized and demonstrated by Inuit than the qualities I have outlined.

It should therefore not be surprising that the Inuit and other native groups have rejected much of the science of wildlife biologists, their methods and results, and the regulations they imply. Participation, including meaningful communication is at the heart of being Inuk. Wildlife biologists are trained in biology, not in social work and in the subtleties of communication and the development of participation. Being on new and uncomfortable ground, they have often left brief notices of intent in communities and quickly gone to follow the herds where they feel more comfortable with the subject matter before them.

Acceptance of a non-participatory status, something much less than what is understood by meaningful communication and of the regulations and regimes which result, implies the abrogation of being Inuk. To be able to hunt without being Inuk is clearly a meaningless form of expression.

Resolution

The resolution of issues related to renewable resource management involves some obvious, well-documented and necessary changes in the political structure of the Territories

and in the allocation of responsibility for game management. Unfortunately, the move toward more local autonomy and responsibility does not fit well with national policy and the federal position respecting the North and its energy and mineral resources. I do not share Rees' (1978) optimism that there is or will be a move toward increased local autonomy and responsibility, apart from in those limited areas unlikely to interfere with resource development. C.M. Dury's efforts (1980) to improve *representative* government in the Territory do not adequately recognize the tradition of *participatory* and consensus decision-making which characterize Inuit society.

However, there are related and alternative actions which could address the current crisis of renewable resource management, including:

— the division of the Territories into east and west along the tree line. This would improve the opportunities for native people in both the east and west to participate in decision-making and would recognize the differences between the geographical regions and the people occupying them.

— ongoing attempts to address other social issues which potentially divide native people internally. As long as conflict around renewable resource management serves a useful social function it is likely to persist.

— an alliance between rural communities in southern Canada experiencing non-renewable resource development pressure and renewable resource management problems (including agriculture) and northern communities experiencing similar problems. While the Canadian Council on Rural Development has done an excellent job of enumerating principles of relevance to rural development (CCRD 1973) there is an acute need for more face-to-face contact, sharing and co-operation between rural northern and southern communities. With the support and understanding of rural southern communities, native communities have greater strength and, importantly, a growing understanding within the majority culture. The renewable resource management problems of many southern agriculturally-based communities and northern settlements are different in detail but remarkably similar in principle.

— the acquisition of greater knowledge by biologists and wildlife managers of the social, psychological and cultural factors of relevance to the populations their efforts should ideally serve. This implies that field biologists and wildlife officials need more than intensive training in biology. There is a need for serious and in-depth training related to human needs, values, the act of valuing, differences across cultures, the importance of and subtleties of meaningful communication and the significance of participation. There is also a need for skill development in this regard. A distinction is to be made here between a commitment to meaningful interpersonal relationships and public relations. The intent is to achieve the former and to deny any role for the latter.

  Biologists, wildlife officers and other relevant personnel are otherwise likely to find themselves in situations personally frustrating, and working at cross-purposes to their intended commitment to the well-being of native populations. People cannot be divorced from the biological resources on which they depend.

— ideally, the management of renewable resources by local populations. This does not imply that management should ignore the geographical area to which the species in

question relates. One of the problems of management is that native understanding of the dynamics of populations is based on relatively local perceptions; in the face of critical problems and population levels, the need for co-ordinated efforts and an appropriate regional perspective becomes essential. In the case of the Kaminuriak caribou herd this necessitates that any participatory management unit bring together the Cree of Northern Saskatchewan and Manitoba with the Inuit of the Keewatin.

Will Participation Work?

There is some evidence that participation and the guarantee of native rights to hunt, trap and fish can result in effective management. It is the capacity to achieve self-actualization through participation as a result of having control over renewable resources which could result in greater acceptance of conservation measures and reduced conflict with wildlife biologists. The evidence for this is to be found in the James Bay and Northern Quebec Agreement (JBNQA) where the principle of conservation was accepted along with a right to harvest. This right to harvest is only subject to a principle of conservation.

> 'Conservation' means the pursuit of the optimum natural productivity of all living resources and the protection of the ecological system of the territory so as to protect endangered species and to ensure primarily the continuance of the traditional pursuits of the Native people, and secondarily the satisfaction of the needs of non-Native people for sport hunting and fishing.
>
> (JBNQA: Paragraph 24.5.1)

At the same time, authority over wildlife and environment was sought by the native people and was the source of conflict in negotiation of the JBNQA. The necessity of relating the management unit to the geographical range of the species in question is reflected in the composition of the co-ordinating committee which has a consultative and supervisory role. Through the right to establish and bind governments to the maximum number of moose and caribou taken in the territory and to the maximum number of black bear taken in the area where non-native hunting of this species is permitted, the co-ordinating committee in effect can regulate, due to guaranteed allocations of harvests, the sport and native harvest of these species (Feit 1979).

The fact that the terms of the agreement were acceptable to the Cree of Quebec is some indication that the proposed structures for renewable resource management met local social and psychological needs. However, the elaborate structures designed to necessarily fit the management schemes of the federal and Quebec governments raise questions about the preservation of traditional and locally-based participatory and concensus decision-making. As Feit points out in his review of these arrangements, some evaluation of them is necessary.

It is suggested that the crisis of renewable resource management can only be met by coming to terms with the notion of participatory democracy as it may relate to native northern communities. Principles related to basic human social and psychological needs must also play a greater role in the activities and deliberations of management personnel and within the research community. In doing so there may be uncovered some important principles and developments of relevance to us all.

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THE TIME FOR TOKEN ESKIMOS AND SECOND-HAND INFORMATION HAS PASSED

Some notes on the problems of communication between the scientific management sector and Inuit users of renewable resources in the North

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Free and adequate information is not only a goal; it is also a means of bringing about social change. Without adequate and effective communication, economic and social development will inevitably be retarded and may be counter-productive.

Wilbur Schramm
Mass Media and National Development

The lack of communication and information exchange between the scientists/managers and the Inuit users of renewable resources has in the past created many problems and will no doubt continue to do so unless corrective action is taken.

There are many hindrances to effective communication and information exchange. Among the main obstacles are differences in cultural attitudes and perceptions as well as practical problems. A major stumbling block to communication between the two groups is their totally different perceptions of the land and its resources as well as their perception of the benefits to be derived from it. This leads to two very different relationships to the land and consequently, to very different concerns. To the management sector, the land might be viewed in terms of cost-effectiveness and short-term profits, to the Inuit users the land might be seen in terms of heritage, culture, subsistence hunting and the ensurance of continued long-term survival. Even the very concept of the "the land" differs in the two groups; to the Inuit the ice and the water are part of their land because this is where they hunt.

At a meeting held recently in Frobisher Bay to discuss the Arctic Pilot Project there occurred a very specific example of how different perceptions can lead people to think differently and therefore to ask different quesitons. The representatives from Petro-Canada came to the meeting well prepared to answer all questions. That is, all the questions they thought would be asked. A Greenlander surprised the Petro-Canada representatives by asking what do the tankers smell like? Have you done any research on whether or not the seals like the smell of your ships? Well, this turned out to be an area where no research had been done, presumably because the questions had not occurred to any of the non-native researchers and yet it may well prove to be an important question that should have been studied.

The differences between the scientific/technological education of the southern-trained scientist and the more experiential "school of nature" training of the northern user also makes communication difficult. The same can be said about the two groups' different ways of decision-making and generally "doing business". The small number of Inuit who have

thorough scientific or managerial training is another factor, and one that cannot be overcome by appointing "token eskimos", but only by training and appointing more Inuit to high-ranking and responsible positions with the powers of direct decision-making.

However, these cultural and perceptual differences are only some aspects of the problem; there are also many practical obstacles to communication between the two groups. Language is a major problem. The use of translations often makes the information somewhat second-hand and often very late. Translation is also often impossible as Inuktitut has not yet developed a scientific vocabulary; for example, the background reports for the Lancaster Sound Region (Draft Green Paper) were published in Inuktitut, "except for those on geology and oceanography where the scientific terminology made translation into Inuktitut impossible" (Dirschl 1980).

Up until now there has been no media in the Canadian North which specifically aimed to inform the Inuit in Inuktitut about national and international scientific news and events. This situation might be alleviated by the future activities of the Inuit Broadcasting Corporation and publication of such new magazines as "Caribou News".

But probably the greatest deterrant to effective communication between scientists, managers and Inuit has been the absence of a consistent and continuing mode of consultation between the parties. There has been no body which systematically collected and dispensed scientific knowledge to the Inuit and between the Inuit in the circumpolar regions.

The Inuit Circumpolar Conference (I.C.C.), the international Inuit organization founded in 1977 to further communication and co-operation at all levels among the Inuit, is keenly aware of these problems.

Last summer, at its general assembly in Nuuk (Godthaab), Greenland, several resolutions were passed; the two most pertinent to the communication problem in connection with renewable resources are:

Resolution number 80-14

> WHEREAS, Inuit have aboriginal rights and interests in cetaceans, fish, marine mammals and fowl which are unique to indigenous peoples;
>
> WHEREAS, such living resources are essential to Inuit cultural survival and serve as a continuing vital source of food for Inuit;
>
> WHEREAS, government research methods and procedures are often inadequate or inconclusive and have been used to adversely affect Inuit rights and interests;
>
> WHEREAS, despite these special rights and interests of Inuit, research and policies are often carried out without adequate consultation with or participation by Inuit in such activities;
>
> WHEREAS, such living resources are being increasingly subjected to international agreements and regulation;

NOW, THEREFORE BE IT RESOLVED:

1. That Inuit from each member state should seek from their respective governments direct participation in the committees or bodies within their respective countries which a) determine government policy on the international level and which b) undertake scientific research on which such policies may be based.

and Resolution number 80-22

WHEREAS there is a need to protect and develop the renewable resource of the Inuit homeland;

WHEREAS many species of renewable resources of the Inuit homeland have been dangerously depleted or made extinct;

WHEREAS there is a need to replenish or re-establish such species of renewable resources in order to protect Inuit economies;

BE IT RESOLVED that the Executive Council of the I.C.C. take all steps necessary to research, assess and coordinate data with respect to the health and welfare of those species which are in danger of depletion or extinction;

BE IT RESOLVED that the Executive Council make reports and recommendations to both the General Assembly and the member parties with respect to their findings on a regular basis;

BE IT RESOLVED that such report and recommendations take into account the need to prevent introduction of new species into the Inuit homeland without adequate prior scientific research and consent of the Inuit.

The I.C.C. has now started to implement these resolutions by setting up a Committee for Renewable Resources. At its first meeting in May, 1981, the committee voiced its concern over the ". . . information problem. We know that very important scientific studies have been carried out in the various regions but these studies often seem to disappear in the different universities and other organizations. Furthermore, these regional studies are never assembled to provide an overall picture of the situation". The committee also found that ". . . the over-all view of animal life is extremely important . . . it is for example, of definite importance in the evaluation of the consequences of oil drilling in the sea or the routes of supertankers". This need for an "over-all view" was at the center of the committee's discussions (I.C.C., Press release, May 1981).

The I.C.C. Committee for Renewable Resources met for the first time in the same month as the International Symposium on Renewable Resources and the Economy of the North was held in Banff, where similar needs were discussed. For example, Dr. F. di Castri, Secretary of the International Co-ordinating Council for the Man and Biosphere Program (M.A.B.) of UNESCO, suggested the formation of an informal arctic network of information exchange and research planning under the auspices of the M.A.B. program; this suggestion was endorsed and pursued later in the Symposium and is reported upon elsewhere in this volume.

A workshop on co-operative research also took place. After discussions among the Inuit and non-Inuit there, a series of suggestions and resolutions were agreed to, that all underlined the need for co-operation, consultation and mutal information exchange. The workshop also fully endorsed the *Ethical Principles for the Conduct of Research in the North* proposed by M.A.B., which also speaks to the principles of co-operation and consent.

Having participated in the co-operative research workshop, I would like to offer the following observation in these notes.

If one analyses these ideas, which all seem to go in the same direction, it becomes apparent that a major way to overcome communication problems is to have direct co-operation and communication between the proposed M.A.B. international network for northern science and the I.C.C. Committee on Renewable Resources, either by having each group work side by side or by setting up a joint body. If there was to be such direct input from Inuit in Canada, Alaska, and Greenland it would not only help to overcome many of the cultural and practical obstacles to effective communication, it would also be a unique example of co-operative research and would benefit both the non-Inuit scientists and the Inuit. It would provide an example of co-operation at other levels.

As I.C.C. also has committees working on education in the North and on communications as well as plans to start publishing a circumpolar magazine before the end of the year, the information and experience gathered from a joint venture by M.A.B. and I.C.C. would not only have an immediate effect on renewable resources management and research, but, would also have a very beneficial long-term effect on education and the dissemination of information in the North. It would be Inuit talking to Inuit. It would do away with "token Eskimos" and second-hand information and would contribute positively to economic and social development in the North. It would close the communication gap and thereby facilitate the rational management of renewable resources in the north.

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IMPACTS OF INDUSTRIAL EMPLOYMENT ON HUNTING AND TRAPPING AMONG CANADIAN INUIT

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Recent proposals for resource development projects in the Northwest Territories have evoked responses from many people that these projects would lead to "cultural genocide" among the native people affected (Berger 1977). In the context of the regulatory body hearings in which these assertions are made, the term cultural genocide is rarely defined. Clearly the term envisages the destruction of the semi-traditional way of life now found in most northern native communities. This life style is termed "semi-traditional" because of the very significant changes which have taken place in living patterns among native people in recent decades. An incomplete listing of these changes includes:

- the almost universal abandonment in Canada of the traditional semi-nomadic life;
- attendance of children at schools teaching a largely southern Canadian curriculum;
- dependence on nursing stations located in virtually every settlement and on emergency medical evacuations for modern health care;
- dependence on family allowance, old age assistance, social assistance and other transfer payments (i.e. Local Improvement Project grants) for significant portions of the cash flow in many communities;
- dependence on increasingly large and well-stocked stores for significant amounts of the food consumed and for most of the clothing, as well as for virtually all of the tools, utensils, weapons, camping gear, etc. that are now used.

In so far as religion, which is concerned with "ultimate reality", has anything to do with meaning in life, the disruption and replacement of traditional meaning systems resulting from the complete displacement of traditional religious beliefs by Christianity is another case in point.

Perhaps the most valid concern about possible "genocidal" impacts of resource development and other industrial employment on native people relates to effects of the developments on the continued harvesting of renewable resources: fishing, hunting of game, and hunting and trapping fur-bearers. The seriousness of this possibility is due to the fact that these activities are central to the ethos and dominant themes of the existing native cultures. These themes focus on love and knowledge of the land, being able to live on the land, depending on and harvesting its resources, and sharing the harvest of game and fish among kinsmen and friends. We see here the convergence and the mutual strengthening of four of the most important emphases in the contemporary native cultures: love of the land, veneration of the elderly who are the repositories of the traditional lore relating to comfortable survival on the land, dependence on the renewable resources which may be harvested given mastery of this lore, and sharing the yield of hunting and fishing expeditions with traditionally-defined persons who will share the yield from their own efforts in return.

The critical question, which must be taken seriously, is: does increased industrial or wage employment jeopardize this surviving core of traditional culture? At issue here is not

whether or not these cultural elements *should* survive — it is enough to indicate that large numbers of native people have insisted that they want them to survive. Some might wish to argue that the real threat to the survival of this cultural core is the now near-universal public schooling of native children in the Territories — schooling which has very little relevance to traditional interests. But more important than the schooling is the range of opportunities that are available to mature adults, to provide support for themselves and their families, in shaping the context of cultural continuity and change.

The case to be made that industrial employment would strike a death blow at the traditional cultural interests would seem obvious. Generally speaking the economic returns from industrial employment are larger, and more dependable. The conditions under which these returns are earned are much safer in terms of physical risks, as native people usually recognize (Hobart, in press), and more comfortable and attractive in terms of working conditions. Accommodations, subsistence, and leisure-time opportunities are typically more attractive as well, if one contrasts the home community or the rotation employment facilities with those available at the camp pitched along the trapline, the bush camp, or the sealing camp along the Arctic coast.

The increasingly spacious and well-stocked stores, which are found in most native settlements, add to the attractions of wage employment; a relatively large and dependable pay cheque gives its earner sure access to the variety of stock in the store, be it new skidoos or boats or rifles, "high-fi's", television sets, or cameras, appliances or furniture, attractive gadgets, toys for the children, clothes and boots, or candy, pop, and other junk food. Most communities also experience a thirst for liquor which may be mail-ordered from the government operated liquor warehouse, unless local prohibition is in effect.

However there is a contrary case to be made as well. Perhaps the most significant points are that to date virtually all of the available wage employment, aside from the relatively few community servicing jobs, is available in white-oriented, and white-dominated contexts. Moreover most of the white people in these contexts have little real feeling, much less concern, for the sensibilities and the psychology of native people. Whites typically feel justified in this insensitivity by time constraints, deadline pressures, and considerations of efficiency and production. Moreover the prejudices and discriminatory practices characteristic of our society which make themselves felt, albeit in subtle ways, add to the feelings of uncertainty and alienation that native workers feel in such employment situations.

In brief, to be a Canadian native industrial worker would seem inevitably for most to be caught in an alien context, and trapped among typically boorish and childishly-acting strangers (Briggs 1970). The tensions which such a worker may typically experience are aggravated by his inability to share his stressful feelings with others, as Briggs shows (1970).

It must be added however, that there is the possibility of a compromise, which could involve some alternation of wage employment and resource harvesting, such that the native person enjoyed "the best of both worlds". The most obvious opportunity for that would be in the context of rotation employment, where the worker is at an industrial work camp for a few weeks, and thereafter is home for one or two weeks. In fact, most of the industrial employment which is now available to native people in the Canadian Arctic, and most of the opportunities projected to open up during the next few years, is precisely of that kind.

The Data

During the past decade there have been three employment experiences involving native people in the Northwest Territories which afford an opportunity to assess the impacts of industrial employment on some of the central themes of the native cultures. These experiences include the on-going program of Panarctic Oils which, starting in 1970, began employing Inuit from Arctic Bay and Pond Inlet in their hydro-carbon exploration program in the High Arctic, the program of Gulf Oil Canada employing Inuit from Coppermine in their exploration program in the Mackenzie Delta between 1972 and 1978, and the employment of Inuit workers from Arctic Bay, Pond Inlet, and Igloolik, as well as smaller numbers from other communities, in construction and operation of the Nanisivik mine, which began in 1974. Data are also available on other employment which Coppermine Inuit have found since termination of the Gulf Oil employment, including opportunities with Dome Canmar, and with Echo Bay Mines.

Information available for each of these employment situations includes the number of men employed from the communities in question and their total earnings from each project for each year since the onset of the project. Good information is also available on fur harvests over a longer period, which permits establishing a pre-employment baseline for comparison with the post-employment situation. Some relevant information is also available on game harvests.

It may be noted that the substantial employment available to native people in the Mackenzie Delta communities has been ignored in this listing of recent and current industrial employment opportunities; there are two important reasons for this omission. The first is that adequate, comprehensive data are not available on numbers of men employed and the amount of their earnings during this period. Information on the number of men employed is to be found in the reports of the Petroleum Industry Committee on Employment of Northern Residents, for 1974 through 1978, but their figures do not include the many native people working for small businesses and in the service industries in these communities during that time. The second reason is that many of the Delta communities were heavily impacted by temporary and semi-permanent white residents during this exploration boom period. Thus the effects of the industrial employment on resource harvesting are compounded with the impacts of large numbers of white transients and immigrants, in Inuvik and Tuktoyaktuk in particular.

Most of the data reported here were gathered by the author or his student (Roberts 1977), from local surveys, relevant industrial employers and Territorial government sources. Surveys were conducted in Coppermine by the author in 1973, 1974 and 1978, and in Arctic Bay and Pond Inlet by Roberts in 1974, and by the author in 1976 and 1978. Data on fur and game harvests were obtained from the Fish and Wildlife Service of the Government of the Northwest Territories and information on social assistance payments was obtained from the Territorial Department of Social Development. Information on values of carvings and handcrafts was supplied by the Canadian Arctic Cooperative Federation. The population figures cited are from various publications and projections of the Statistics Section of the Government of the Northwest Territories.

In the following pages we review the available evidence bearing on the impacts of industrial employment on renewable resource harvesting, first in Coppermine, and then in Arctic Bay and Pond Inlet, following a brief historical introductory statement on each community.

The Coppermine Situation

The ancestors of the "Copper Eskimo" as Jenness (1922) called them have hunted in the Coronation Gulf area, where the hamlet of Coppermine now stands, for many hundreds of years. Their first contact with Europeans occurred in 1771 when Samuel Hearne's party descended the Coppermine river, but it was not until about 1915 that contacts became continuous. When Diamond Jenness, an anthropologist with the Canadian Arctic Expedition of 1913-1918, lived among them he found that iron and steel utensils were just replacing traditional bone and stone tools, and rifles were beginning to replace bows and arrows (Jenness 1922). Traders, missionaries, and Royal Canadian Mounted Police all arrived in the Coronation Gulf area about 1915.

Following location of a nursing station on the current site in 1948, the settlement began to grow more rapidly: shortly thereafter a school was built and then a generating station to supply power to these facilities. However, the population remained semi-nomadic and as recently as the early 1960's many families were still living in very small snow-banked tents when in the settlement in winter. However, such dwellings had all disappeared by the turn of the decade, and the now much expanded population was living in housing supplied under the Canadian Eskimo Housing Act. By 1971 the population had grown to 732, of whom about 88 per cent were Inuit, and the rest were white.

Until the fall of 1972 most of the families in the community continued to be primarily dependent on resource harvesting, supplemented as necessary by social assistance payments, for their livelihood. The exceptions were those who had local service employment of one kind or another. There was also a modest amount of casual labour employment available during the summer, unloading the supplies that came by sea or occasionally helping in the construction of a building. A survey taken in July 1971, during the high employment season, showed that 26 men and eight women were employed full-time and 34 men and five women were employed part-time. Wage employment in Coppermine from all sources from the fall of 1971 to the fall of 1972 was estimated at $225,000.00.

As described elsewhere (Kupfer and Hobart 1978), Gulf Oil began employing Coppermine Inuit during the fall of 1972 in oil exploration work in the Mackenzie Delta. The Inuit worked a rotation schedule, just as did southern white employees, involving two weeks on the job, working 12 hours a day, followed by one week at home. Their living conditions and wage rates were identical with those of southern employees. This employment lasted a total of seven years, but the last two were essentially "wind down" years as the exploration program was terminated. During the first year a total of 55 Inuit were employed, from November 1972 till May 1, 1973, for varying lengths of time. Average earnings per employee were $2956.00, and total earnings from Gulf Oil amounted to $162,500.00, as shown in Table 1. This employment peaked in 1976-77, when a total of 90 Coppermine Inuit earned a total of $623,500.00, or $6928.00 per employee from this employment. During this period the contribution of Gulf Oil earnings to the total community cash flow increased from 28 per cent in 1972-73, to a maximum of 38 per cent in 1975-76. By the latter year, for many Inuit this had become year-round rotation employment and the Coppermine Inuit were one of the most dependable components of Gulf Oil's northern work force.

With the termination of Gulf Oil exploration activity in the Delta in 1977, employment with Gulf Oil involved only site-dismantling and clean-up activity which were completed by mid-1979; therefore there was a major decline in Gulf Oil earnings during the last two

Table 1. Monetary income from all known sources for Inuit residents of Coppermine, 1971-72 to 1979-80.

	Years							
	1971-72		1972-73		1973-74		1974-75	
	Amount	%	Amount	%	Amount	%	Amount	%
Gulf Oil Employment	$ —	—	$162,500	28	$273,700	30	$ 329,300	30
Canmar Employment	—	—	—	—	—	—	—	—
Local Wage Employment[2]	225,000	56	233,000	40	255,000	27	390,000	36
Fur Sales	32,592	8	30,100	5	163,509	18	59,075	5
Carving and Handicrafts[3]	52,800	13	67,000	11	82,500	9	89,500	8
Old Age Pensions, Child Allowance Payments[4]	60,312	15	66,742	11	101,171	11	146,347	13
Social Assistance Payments	31,789	8	27,357	5	51,706	6	71,806	7
Mining and Exploration	—	—	—	—	—	—	—	—
Total	402,493	100	586,799	100	927,586	101	1,086,028	99

1975-76		1976-77		1977-78		1978-79		1979-80	
Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
$ 615,761	38	$ 623,500	34	$ 273,332	18	$ 52,978	3	$ —	—
—	—	6,400	0.3	51,853	3	190,000	10	288,000	14
540,000	34	680,000	37	727,600	48	785,800	41	840,800	40
98,748	6	164,534	9	82,632	5	331,734	17	223,522	11
97,000	6	111,500	6	127,200	8	146,500	8	120,119	6
158,936	10	169,218	9	170,400	11	184,032	10	200,900	9
101,069	6	88,066	5	79,862	5	124,789	7	198,698	9
—	—	—	—	6,033	1	81,776	4	245,900	12
1,611,514	100	1,843,218	100	1,518,912	99	1,897,609	100	2,117,939	101

Note: 1. Percentages may not total 100 due to rounding.
2. Extrapolated from figures available for 1971, 1972, and 1977.
3. Extrapolated from figures available for 1971, 1977, 1978, 1979, and 1980.
4. Calculated from Statistics Canada age distribution data for Coppermine.

years. However, the work discipline, technical skills and reputations that the Coppermine men had acquired made them attractive candidates for other northern industrial employment and more and more of these former Gulf Oil employees were hired by Dome Canmar for their Beaufort Sea exploration operations and by the mining industry. As a consequence, the income from non-local industrial employment in Coppermine, which dropped from 34 per cent of the community cash flow in 1976-77, to 22 per cent in the following year and to 16 per cent in 1978-79, had risen to 28 per cent in 1979-80. The number of Coppermine men employed in these industries in the latter year was 47, so that their average earnings were over $11,000.00. At the same time the population of Coppermine was growing rapidly, from 732 in 1972 to 849 in 1980.

While these figures show that industrial wage earnings were high during much of the period under consideration, they are, nevertheless, overshadowed by the value of income in kind: the caribou, fish, wildfowl and seal harvested by Coppermine Inuit for domestic consumption. Unfortunately, reliable harvest figures are not available. However it is possible to estimate the value of this game and fish harvest, for in recent years there have

never been shortages of game foods and the diet of Coppermine Inuit remains very heavily dependent on country foods. If we assume that on the average one and a half pounds of wild food are consumed per capita throughout the year, and that the protein replacement value of this food during the first employment year was about $3.00, the value of the income in kind thus consumed would have been about $1,215,450.00, or more than twice the total monetary income for the settlement in that year. Proceeding in the same way, but assuming that by 1980 the protein replacement value of this country food would have been about $6.00, the total value of this income in kind during 1980 would be $2,789,000.00, or almost one-third larger than the total monetary income during the 1979-80 employment season. There may be disagreements with some of the figures assumed in making these estimates, but clearly the value of these local harvests is relatively very large.

The point of particular interest to this study is that there was a five-year period, from the winter of 1972-73 to the winter of 1977-78, when industrial earnings of Coppermine workers increased from year to year by between 56 and 86 per cent in every year but the last. It may be said that if ever there was a situation when industrial employment might be expected to have adverse effects on resource harvesting it was then, when industrial wage earnings were climbing steadily and rapidly, and without a break. What in fact was happening to hunting and trapping activity during this period?

Reliable objective data are available on fur harvests for the period from 1968-69 to 1979-80 including species-specific figures as shown in Table A1 in the Appendix. The proportions that Coppermine fur values comprise of total Territorial fur values for these years are found in Table 2. The figures in these tables reflect fluctuations, particularly in the fox cycle and in market prices. However they certainly do not suggest any progressive decline in trapping activity as the availability of industrial employment increased. Rather there are indications of increased trapping in the years after this employment became available. This is seen more clearly if the fur earnings are pooled for three-year periods, for both Coppermine and for all the N.W.T., in order to minimize annual fluctuations. When this is done, the calculations show that during three years preceding onset of the industrial employment, 1968-71, Coppermine fur earnings comprised 3.2 per cent of the Territorial total. During the 1971-72 to 1973-74 period this figure was 3.9 per cent; during 1974-75 through 1976-77 it was 3.6 per cent, and during 1977-78 through 1979-80 it was 4.2 per cent.

Unfortunately there are no comparably accurate data on harvesting of game and fish for this period. Harvest statistics are collected once a year by the Territorial Fish and Wildlife Service, but these returns are based upon the memories of the hunters and so are of unknown reliability. Instead we must depend on reports from informed, long-term residents of Coppermine, the local Catholic priest, the Settlement Manager and others, obtained in 1973, 1974 and 1978. Without exception they indicated that there had never been any shortage of meat in Coppermine during the Gulf Oil employment period, and that it had been at least as abundant in the community during these years as it had been before the onset of this employment in the fall of 1972. Throughout both the pre-employment and the employment years, meat was in plentiful supply because caribou herds could easily be reached on motor toboggans from the settlement, so that most hunting trips took only one day. In fact these informants were of the opinion that for residents of this community an abundant meat supply had become more dependably available during the employment years, for reasons to be discussed later.

In conclusion, the Coppermine data have shown no indications of a decline in resource

harvesting as industrial employment in that community has increased. In fact there are indications that harvesting may have increased.

Table 2. Values of fur sold in Coppermine and in the Northwest Territories, 1968-69 to 1976-80.

Year	Coppermine District	Percentage of Total N.W.T.	Total N.W.T.
1968-69	$ 16,653	1.43	$1,159,780
1969-70	33,506	3.17	1,058,134
1970-71	60,693	5.07	1,197,168
1971-72	37,592	2.64	1,424,445
1972-73	30,100	2.11	1,424,396
1973-74	163,509	5.33	3,067,725
1974-75	59,075	2.72	2,175,114
1975-76	98,748	3.60	2,742,480
1976-77	164,534	3.81	4,317,182
1977-78	69,146	1.80	3,837,996
1978-79	331,734	5.77	5,745,452
1979-80	223,522	4.19	5,337,411

Source: Wildlife Service, Department of Natural and Cultural Affairs, Government of the Northwest Territories.

The Arctic Bay and Pond Inlet Situations

There have been contacts between Europeans and Inuit on northern Baffin Island for a long time. Early explorers reached this area as early as 1616 (Baird and Robinson 1945) and with increasing frequency during the early decades of the 19th century. However, it was the arrival of the Scottish and English whalers in the area after 1820 that resulted in close, and disruptive, Inuit-white contacts, which lasted for 90 years at Pond Inlet and other Northern Baffin locales (Bissett 1967; Mutch 1906). Rifles, ammunition and other trade goods came into the possession of the Inuit during the latter half of the 19th century (Matthiasson 1967). Following the abrupt decline of the whaling industry about 1910 the whalers were replaced locally by fur traders. The first small trading post at Pond Inlet was opened in 1903 (Munn 1932). The Hudson's Bay Company soon came to dominate trade in the area, with establishment of posts at Pond Inlet in 1921 and at Arctic Bay in 1926 (Usher 1971). Missionaries arrived shortly thereafter, with both the Anglicans and the Roman Catholics establishing missions at Pond Inlet in 1928 which have existed ever since and a Catholic mission established at Arctic Bay in 1937 (Usher 1971). An RCMP post was first established at Pond Inlet in the early 1930's, but there has never been one at Arctic Bay (Brody 1975).

The consequence of these contacts was to change the technology of resource harvesting, and to some extent the kinds of animals that were taken, with increased emphasis being placed on fur-bearers. However, many aspects of the way of life of the north Baffin Inuit were little changed. Matthiasson wrote in 1967:

> in many respects the culture of the camp continues in the pattern of the pre-contact structure although the participants are irrevocably enmeshed in EuroCanadian culture. The people of today have outboard motors instead of kayaks, use rifles in place of harpoons, eat bannock as a staple and attend church services every Sunday

> morning. Nevertheless, they still make their living as hunters and fishers, respect traditional obligations of sharing and hospitality, and generally identify psychologically as Eskimos (Matthiasson 1967: 76, quoted in Roberts 1977).

The people here, as elsewhere in the Canadian Arctic, lived in scattered hunting camps through the early 1960's, but by the end of that decade all had participated in what was a "virtually complete migration of the people into the settlement", drawn by government-provided, increasingly attractive housing and the establishment of local nursing stations and schools (Matthiasson and Matthiasson 1975). By 1970, the populations of Pond Inlet and Arctic Bay were about 450 and 255 respectively. The sudden increase in population of these former trading sites induced some changes in the economic circumstances of the Inuit. There was a very modest amount of community servicing employment which tended to increase in time. Economic surveys carried out in Pond Inlet in 1956 and 1963 show that the income derived from sale of furs and sealskins declined from 35 to 21 per cent as did that derived from transfer payments, from 32 to 27 per cent. Wage income in the same period increased from 33 to 52 per cent. However the amounts of money involved were very modest: in Pond Inlet the annual per-capita income was only $222.00 in 1963 (Bissett 1967). Despite the increase in wage earnings, opportunities for wage employment were few in number. Bissett reports that in Pond Inlet in 1967 there were permanent wage employment opportunities for only about one in seven working-age males. No industrial jobs were available; the Federal government was the main employer.

This situation was changed with the decision by Panarctic Oils to recruit Inuit workers for its exploration program in the High Arctic islands in 1970. In December of that year workers were transported from Pond Inlet and Arctic Bay to the Base Camp at Rae Point on Melville Island and to remote drilling sites farther north. In common with other Panarctic employees they worked 20 days at these sites, and then were transported home for a 10 day rest period. This schedule remained in effect until about 1978 when it was changed to 14 days at work and seven days at home. As with Gulf Oil employment of Coppermine Inuit, native employees worked the same hours and received the same pay and the same treatment as white workers from the south of Canada.

Information on the amount of employment and wage income which Pond Inlet and Arctic Bay Inuit received from Panarctic Oils is found in Table 3. These figures show that the number of Panarctic Oils' employees has fluctuated between 26 and 67 in Pond Inlet, and between 25 and 45 in Arctic Bay.

In 1974 a second industrial employment opportunity became available to Inuit in this area. Work was begun on the construction of a lead-zinc underground mine, a mill, and small company town for Nanisivik Mine on Strathcona Sound, north Baffin Island in May 1974. Inuit workers were involved from the outset in the construction of these facilities, and later, in the operation of the mine. Again, this was rotation employment but with a much longer work period: six weeks on site followed by two weeks of rest at home, or more if the worker desired. In fact, since the mine site is only 37 km from Arctic Bay the workers from this community have been able to get home on weekends since 1975. After 1976, when a road was completed between the settlement and the mine site, men were able to commute daily to work, though since some worked a 12-hour day the travel time may have been onerous. In any case, since 1974 the men of Arctic Bay and Pond Inlet have had two industrial employment options, working the shorter rotation schedule for Panarctic Oils, or the longer work period at the Nanisivik mine.

Table 3. Wage Income from Pan Arctic Oil, & Nanisivik Mine employment, Pond Inlet and Arctic Bay, 1974-1980.

	Pond Inlet						Arctic Bay					
	Pan Arctic		Nanisivik		Total		Pan Arctic		Nanisivik		Total	
	$	Workers	$	Workers	$	Workers	$	Workers	$	Workers	$	Workers
1974	382,100	48	NA		382,100^A	NA	171,200	39	NA		171,200^A	NA
1975	335,400	67	24,000	2	359,400	69	150,700	35	173,000	20	323,700	55
1976	401,209	51	24,000	2	425,209	53	177,700	41	177,300	15	355,000	55
1977	342,800	40	29,600	4	372,400	44	184,600	45	181,300	27	365,900	72
1978	273,589	39	26,901	3	300,490	42	176,200	41	191,500	17	367,700	58
1979	116,411	26	24,553	2	140,964	28	100,013	25	238,037	16	338,050	41
1980	270,151	41	19,919	1	29,070	42	123,500	30	233,600	18	357,100	48

A — Incomplete; NA — not available.

Data in Table 3 show the numbers of men employed and their earnings from these two employers for the years 1974-1980. Unfortunately, comprehensive data on sources of community income are not available, but figures for 1976 show that in Pond Inlet industrial earnings comprised 70 per cent of the community cash income from all known sources. In Arctic Bay the proportion was 77 per cent, as nearly as total community cash incomes can be established. Certainly the proportions are very large.

The data further show that Pond Inlet and Arctic Bay present rather different patterns: in Arctic Bay the level of industrial income has remained surprisingly constant since 1975, whereas, in contrast, in Pond Inlet there is a surprising and rather consistent pattern of declining levels of industrial earnings since 1974, in both cases ignoring inflationary effects. It would appear clear from this that in Arctic Bay with two contrasting industrial employment options available, one requiring rotation and one permitting the worker to return home every night, the wage needs of the community have tended to remain constant, though the population of Arctic Bay increased by 40 percent, from 303 to an estimated 427 during this seven year period. By contrast, in Pond Inlet where only work involving two week, or six week work rotation periods was available, the demand for industrial wage income has declined, despite a 24 per cent increase in population from about 550 in 1974 to an estimated 686 in 1980. The assertion that demand for wage income has declined is justified by the fact that Nanisivik mine has made the most persistent efforts to increase the proportion of native employees, in compliance with the terms of the Master Agreement signed by the mine operator and the Federal government. Thus the numbers of native mine employees are limited by worker interest, not by employment opportunities.

One significance of these figures, is that in both Arctic Bay and Pond Inlet the per capita industrial wage purchasing power has declined relatively steadily since at least 1975. This in itself comprises evidence that the men of these settlements are not experiencing progressively greater attraction to this distinctively non-traditional means of livelihood.

This conclusion is further substantiated by the fur harvest data found in Table 4, and Tables A2 and A3 for these two communities. As in the case of the Coppermine fur harvest figures, these data show considerable fluctuations. Nevertheless, bearing in mind that Panarctic Oil employment began in December 1970 (though earnings figures are not available until 1974), it appears that between 1971 and 1975 fur harvest earnings were at unusually high levels in terms of the proportion of total Territorial fur harvest values for locally available species. The proportion declines somewhat after 1975, probably because of the very large component that seals comprise of the total fur harvest in these two communities and the low prices available for seal skins, resulting from "Greenpeace" agitation.

When we seek to discover the impacts of industrial employment on game harvesting we encounter the same limitations on available data as in the case of Coppermine during the early years. However beginning with the 1978-79 record year the Territorial Fish and Wildlife Service began collecting harvest data from Inuit hunters on a monthly basis in order to obtain more accurate information. Because of the change in data collecting procedures it would be useless to present data collected previously because they are less accurate and non-comparable with the harvest data for 1978, 1979 and 1980.

These 1978-79 harvest data, showing numbers of caribou, seal, walrus, narwhal and polar bears taken, are found in Table 5. Very high proportions of the adult men in both of these

Table 4. Total value of fur sales for Arctic Bay, Pond Inlet, and the total Northwest Territories.

	Pond Inlet		Arctic Bay		Total		
Year	Value	Percent of N.W.T. Total	Value	Percent of N.W.T. Total	Value	Percent	N.W.T. Total Value[1]
1968-69	$ 5,686	1.4	$ 8,039	1.9	$ 13,725	3.3	$ 415,519
1969-70	3,355	0.7	2,305	0.5	5,660	1.2	454,264
1970-71	5,253	0.7	5,782	0.7	11,035	1.4	776,710
1971-72	27,612	3.3	34,119	4.0	61,731	7.3	847,180
1972-73	11,694	1.3	24,582	2.8	36,276	4.2	872,360
1973-74	35,433	1.4	55,934	2.3	91,367	3.7	2,445,680
1974-75	35,422	2.2	74,913	4.8	110,335	7.1	1,553,870
1975-76	43,394	2.5	49,500	2.9	92,894	5.4	1,722,980
1976-77	50,281	2.0	51,732	2.0	102,023	4.0	2,538,830
1977-78	27,327	1.7	43,690	2.7	71,017	4.3	1,636,720
1978-79	45,773	1.8	75,221	3.0	121,157	4.8	2,500,441
1079-80	44,842	1.8	45,437	1.8	90,279	3.6	2,557,701

[1]Including only those species harvested in the two communities.

Source: Wildlife Service, Department of Natural and Cultural Affairs, Government of Northwest Territories.

communities were issued hunting licenses, and there were abundant kills of seals and narwhal in both communities. Generally the data show an expected pattern of fluctuation, reflecting the impact of varying weather and ice conditions on the harvest. In the absence of baseline comparison data we must turn to the information supplied by the local Territorial game officer to assess the meaning of these figures. Interviews with this officer were conducted in 1974 and in 1978.

In 1974 the Territorial game officer responsible for both Arctic Bay and Pond Inlet reported that although game is less plentiful during the winter than the summer months, the 10-day "long break" from work provided sufficient time for hunters to secure meat for their families. He also indicated that in Pond Inlet where he was stationed, there had been no apparent shortage of meat in the community since the onset of Panarctic Oils employment. Moreover, among the 67 Inuit employees of Panarctic Oils from these communities who were interviewed in 1974, 21 per cent reported that they went hunting everytime they were home on their "long break", and 24 per cent reported that they hunted most of the time (Roberts 1977).

Table 5. Game harvests by species and by community, 1978-1980.

	Arctic Bay			Pond Inlet		
Species	1978	1979	1980	1978	1979	1980
Caribou	390	—[1]	—[1]	930	—[1]	—[1]
Seals	2,240	751[2]	—[1]	2,810	1,024[2]	—[1]
Walrus	20	7	2	90	2	3
Narwhal	65	43	100	130	94	96
Polar Bear[3]	28	10	10	22	16	15

Note: 1. The Baffin Region Inuit Association collected caribou and seal harvest data under contract, but is currently regarding this information as confidential.

2. These figures reflect the number of seal skins sold during years when the price of seal skins was low as a result of "Greenpeace" agitation, but do not include domestic consumption. Comprehensive figures are unavailable as a result of the Baffin Region Inuit Association policy.

3. These figures reflect the quota assigned to these communities. The total number of allowed kills has been taken every year in recent years.

Source: Reports from hunters collected monthly by the Territorial Wildlife Service.

The Territorial game officer who was interviewed in 1978 commented on the harvest figures presented in Table 5. He reported that the low caribou kill figures for Arctic Bay reflect the fact that hunters there do not have convenient access to good caribou grounds, and not the impacts of Nanisivik Mine employment. He said that this employment has had virtually no effect on the availability of wild food in Arctic Bay, because many of the men opting for mine employment are not very good hunters. Shortages of game food in this settlement are almost unheard of in recent years, although the community does experience shortage of caribou meat at times because of difficult access to good hunting grounds; plentiful wild food in Arctic Bay derives from abundance of seals, fish and muktuk (whale skin). Most of the seals are taken during the latter half of the year, and there is much wastage of seal meat which could be frozen and stored, but is not for lack of need. There

are no figures on the fish harvest but it is very large, so much so that fresh or frozen char is available virtually year-round. It is noteworthy that all narwhal meat is wasted, as only the tusks and the skin, or muktuk, are retained. The game officer estimated that at least 2,700 kg. of muktuk were consumed locally last year, and an additional 1,400 kg. sold to Inuit families at the Nanisivik mine site.

The game officer reported in 1978 that the availability of wild food in Pond Inlet is similar to that in Arctic Bay. Caribou supplies are somewhat less restricted, but they are less than adequate because of the distance of the caribou herds. However seal, fish, and muktuk supplies are more than adequate to offset occasional shortage of caribou meat. It can be noted that no walrus or narwhal meat is eaten here, which reflects an immense wastage of potential wild food.

On the basis of the available information we must conclude that the Panarctic Oils and Nanisivik mine employment has had no discernible effect on the harvesting of wild food in these communities though their combined populations have increased by 57 per cent between 1970, when Panarctic Oils employment became available, and 1980. The fur harvest data provide more definite indications of the same conclusion.

It might be objected that rejection of the "adverse effects" hypothesis should depend upon showing an increase in the fur harvest proportional to the increase in the number of men eligible to be hunters and trappers in the community. Unfortunately this could not be done because the requisite demographic data are not available. Moreover such a relatively low percentage increase, over the course of a few years, would be very difficult to demonstrate given the fluctuations in fur harvest figures which we have noted earlier. However as we have noted, the fur harvest figures may reflect some slight increase during industrial employment years.

Discussion

The available data have permitted three creditable tests of the hypothesis that industrial employment would lead to destruction of the traditional culture, if we assume that two valid indicators of this culture are hunting and trapping activity. Available data were collected in three contrasting contexts: in the Eastern and the Western Canadian Arctic locations, in oil exploration and mining work sites, and in rotation employment situations and situations where workers could return home regularly at night. In all three communities the patterns of relationships which were found were similar and were relatively clear. Despite the fluctuations in the fur harvest data, it is clear that these harvests did not decline in any of the three communities as a result of industrial employment, and on the contrary appear to have increased. Similarly, in respect to supply of country foods, there are no indications of a decline in availability in any of the three communities, and it is possible that they may also have become more abundant.

The possibility of increases in resources harvested should not be surprising. There is evidence that in Coppermine, Arctic Bay and Pond Inlet, substantial amounts from wage earnings were spent on resource harvesting equipment, motor toboggans, boats, outboard motors, guns, tents, etc. Thus, for example, in Coppermine during the first employment season, Gulf Oil employees bought 26 motor toboggans and 11 boats, and the following year these numbers were 42 and 18. In Arctic Bay and Pond Inlet during the 1973-74 employment season Panarctic Oils' employees alone bought 45 motor toboggans and nine boats. No data are available for Nanisivik employees. It is clear from these figures that

one consequence of industrial employment in these communities has been a substantial increase in ownership of equipment conducive to efficient and abundant resource harvesting. Throughout the period under consideration caribou hunting has required the use of motor toboggans because there were no more dog teams and the caribou were too distant to be conveniently reached on foot. The increased local purchasing power has allowed more men to outfit themselves as hunters. In addition, others — fathers, brothers or older sons of workers — acquired an old motor toboggan when the industrial wage worker bought a new vehicle. The same was true of availability of boats, rifles, tents and other necessary gear. As a result of this process the number of men equipped to hunt and trap efficiently and effectively was substantially greater than it had ever been before, as the Settlement Manager in Coppermine emphasized (Hobart, in press).

There is an interesting contrast between the Coppermine and the Arctic Bay and Pond Inlet employment data. The Coppermine data show that during the period of Gulf Oil employment there was a steadily increasing involvement. By contrast, in both Arctic Bay and Pond Inlet there appears to be a pattern of declining involvement, when increases in population size are taken into consideration. An explanation may be that Gulf Oil appears to have provided more encouragement and opportunities for advancement than did Panarctic Oils. In any case in Pond Inlet, rather than having found industrial employment progressively more attractive, the reverse was clearly the case: and in all three communities the lure of the land has remained strong.

It is clear from the testimony and discussion of Inuit in many situations that hunting, trapping and other more traditional land-based activities all have powerful symbolic and identity-fixing significance for Inuit today. These influences may be as strong as other pragmatic considerations in motivating continuing high levels of resource harvesting and other land-based activities. There is no evidence that either is less strong in Coppermine, where involvement in industrial employment increased steadily, than in the Baffin Island communities where it did not. It should be emphasized that although an adequate base of relevant data is rarely available, there are other employment situations where the same findings hold true. A case in point is among Indian workers hired by Gulf Minerals Canada to work at the Rabbit Lake uranium mine in northeastern Saskatchewan. These Indian employees, from Black Lake, Fond du Lac and other small bands in the area work a rotation schedule involving seven days at work and seven days at home. Community impact self-surveys have established the fact that substantial numbers of these workers go on hunting trips during their "long break" at home, and that mine employment has not induced a decline in the amount of country food available in these communities (Beveridge and Schindelka 1980).

On the basis of the evidence that we have reviewed it seems clear that industrial employment has not been associated with decreased involvement in traditional land-based activities. However it should be emphasized that in every case but the Arctic Bay employees at the Nanisivik mine, the native workers are involved in rotation employment, where they return to their home community at the end of their rotation period. Even the Arctic Bay community is insulated by 37 km of road from the Nanisivik mine. The consequence is that the employment situation does not directly impinge upon the native community. Moreover the fact that employment requires separation from family, gives the home community an especially attractive emotional significance which may help to insulate the worker from becoming more deeply acculturated, as contrasted with learning new roles appropriate and specific only to the work site. Employment effects in Tuktoyaktuk, where Dome Canmar has established a sizeable base camp adjacent to the native settlement which

has itself long been powerfully exposed to the acculturative influences emanating from Inuvik, has not been studied to date. Fortunately there is virtually no overlap between the oil exploration season and the caribou hunting and fur-trapping seasons. However, the fishing and migratory-bird hunting seasons do not directly conflict with the employment period.

There is some evidence that relocation of native families to white-dominated communities adjacent to industrial work sites is strongly disruptive of traditional harvest activity for several reasons, as is shown by the experience of Inuit who have relocated their families to the Nanisivik mine community. The interests, activities and aspirations of such Inuit may be influenced by white values which are far from land-oriented. More important however is the strangeness of the hinterland surrounding the relocation site, for not only does the relocated worker not know the movement patterns of the animals on this land, but he may also be rightly afraid of getting lost, a possibility not to be taken lightly. In addition, most Nanisivik employees work six days a week, leaving only single rest days which allow an inadequate period of time for serious hunting trips. As a consequence of these concerns and conditions it appears that Inuit who have relocated to Nanisivik have done virtually no hunting in this new area.

There can be no questioning the seriousness of interest and the depth of commitment of most northern native people to perpetuating the resource harvesting and essential aspects of the country-based life style which has such profound economic and symbolic significance for them. There is growing evidence that in many communities these interests may be most effectively and persistently pursued where the availability of rotation employment provides both the means of acquiring needed equipment, and the necessary blocks of leisure time, without undercutting traditional interests and symbolic identifications.

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APPENDIX

Table A1. Indications of trapping-hunting activity in Coppermine, 1968-69 to 1979-80

Year	No. of Trappers	White Fox		Other Fox		Wolves		Polar Bear		Seals		Total Value[1]
		No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	
1968-69	89	211	$ 2,983	40	$ 461	6	$ 192	—	$ —	1,994	$13,037	$ 16,653
1969-70	143	549	6,963	101	1,168	8	280	3	666	2,279	24,429	33,506
1970-71	116	2,098	29,624	68	645	6	240[2]	2	560[2]	2,098	29,624	60,693
1971-72	162	1,642	18,452	29	216	3	133	1	339	1,642	18,452	37,592
1972-73	89	134	2,315	34	545	2	62	—	—	1,956	27,169	30,100
1973-74	114	4,250	115,061	218	7,793	23	1,110	1	1,000	2,146	38,178	163,509
1974-75	160	1,230	21,340	43	1,007	162	8,670	1	650	1,570	26,841	59,075
1975-76	148	1,808	45,076	148	5,859	111	10,230	—	—	1,880	35,925	98,748
1976-77	141	3,188	106,899	230	11,073	40	6,490	—	—	2,279	37,307	164,534
1977-78	133	848	25,313	185	12,912	43	5,919	2	2,800	1,872	22,202	69,146
1978-79	156	1,679	69,482	723	66,180	1063[3]	165,456	5	7,500	1,618	19,890	331,734
1979-80	N/A	2,583	97,328	598	40,765	234	40,893	5	6,400	1,982	38,136	223,522

Note: 1. Includes value of fine furs taken.
2. Value estimated.
3. Includes 284 wolves used locally or shipped to Holman, not included in value totals.
Source: Data supplied by Fish and Wildlife Service, Government of the Northwest Territories.

Table A2. Indications of trapping-hunting activity in Arctic Bay, 1968-69 to 1979-80

Year	No. of Trappers	White Fox		Other Fox		Wolves		Polar Bear		Seals		Total Value[1]
		No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	
1968-69	N/A	491	$ 5,995	—	$ —	—	$ —	13	$ 2,044	—[1]	$ —	$ 8,039
1969-70	N/A	296	84	—	—	—	—	10	2,221	—[1]	—	2,305
1970-71	N/A	296	3,641	—	—	—	—	10	2,141	—[1]	—	5,782
1971-72	N/A	1,510	17,093	13	182	7	312	13	4,417	1,235	12,115	34,119
1972-73	N/A	275	5,038	1	25	2	1,227	12	7,193	735	11,099	24,582
1973-74	60	381	11,510	59	2,478	1	59	13	13,958	1,614	28,019	55,934
1974-75	71	257	45,206	—	—	—	—	12	7,682	1,288	22,025	74,913
1975-76	65	159	4,083	2	96	2	218	6	2,699	1,793	42,404	49,500
1976-77	73	776	27,400	14	770	10	1,387	11	6,476	924	15,699	51,732
1977-78	44	396	11,623	3	195	11	15,140	11	7,896	745	8,836	43,690
1978-79	67	412	17,528	15	1,270	2	550	28	42,005	944	13,868	75,221
1979-80	N/A	470	21,596	2	104	5	870	10	9,100	733	13,767	45,437

[1]Seal harvest data not available.
N/A — Not available.
Source: Wildlife Service, Department of Natural and Cultural Affairs, Government of the Northwest Territories.

Table A3. Indications of trapping-hunting activity in Pond Inlet, 1968-69 to 1979-80

Year	No. of Trappers	White Fox		Other Fox		Wolves		Polar Bear		Seals		Total Value[1]
		No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	
1968-69	N/A	324	$ 3,956	—	$ —	—	$ —	11	$ 1,730	N/A	$ —	$ 5,686
1969-70	N/A	5	70	—	—	5	175	14	3,110	N/A	—	3,355
1970-71	N/A	161	1,980	3	36	7	239	14	2,998	N/A	—	5,253
1971-72	N/A	607	6,817	4	56	5	223	6	2,039	1,878	18,423	27,612
1972-73	N/A	12	220	—	—	—	—	14	859	703	10,615	11,694
1973-74	93	58	1,752	2	84	1	59	14	15,032	1,066	18,506	35,433
1974-75	91	175	3,078	5	140	14	878	9	5,761	1,495	25,565	35,422
1975-76	90	37	950	4	192	4	436	6	2,699	1,654	39,117	43,394
1976-77	100	255	9,004	21	1,155	17	2,357	15	8,831	1,703	28,934	50,281
1977-78	83	121	3,551	10	650	12	1,652	22	15,794	479	5,680	27,327
1978-79	N/A	282	10,833	58	3,551	10	4,023	16	17,331	667	10,037	45,773
1979-80	N/A	112	3,058	14	660	4	1,225	15	18,510	1,024	21,389	44,842

N/A — Not available.
Source: Wildlife Service, Department of Natural and Cultural Affairs, Government of the Northwest Territories.

CARIBOU MANAGEMENT

Workshop Report

Chairman: V. Geist
University of Calgary, Calgary, Alberta

Recommendations in Respect to Legislative Matters

— Recognizing the importance of caribou to the economic, social and cultural life of Native peoples, and to society as a whole, and with a view to ensuring the survival of a precious resource for present and future generations,

It is recommended that governments be urged to adequately support educational, research and information-sharing programs, new and improved intra- and inter-jurisdictional management schemes and bring in required legislative initiatives designed to protect this valuable resource.

— Whereas Canada and the United States have been involved in discussion of an international agreement on migratory caribou herds that cross the international boundary,

and since an international agreement can play an essential and critical role in ensuring protection for the habitat of the herd in both countries,

It is recommended that the governments of Canada and the United States and all interested parties proceed as quickly as possible to bring about an agreement to protect the caribou in question.

—Whereas the Yukon Quartz Mining Act and the Yukon Placer Mining Act are two senior statutes which strongly influence land use and are oriented to encourage extensive mineral extraction rather than integrated resource management through land-use planning,

and whereas the regulations, under the Territorial Lands Act, and the policies associated with the application of the regulations are inadequate to allow sound renewable resource-use planning and protection, particularly for many species of wildlife and fish,

It is recommended that: the Federal and Territorial governments and concerned groups generate new and strong statutes to apply to renewable resource planning, protection and management in Canada's North, and the Quartz Mining Act and the Yukon Placer Act should be revised and updated.

Recommendations in Respect to Management

— Whereas the demand for wildlife is increasing, and the nutritional and cultural value of wild game is high,

It is recommended that ecologically appropriate wildlife species be introduced to suitable habitats. This might include not only introduction of caribou to islands, but also the introduction of reindeer, bison, elk, mountain sheep, and musk-ox to suitable northern locations.

It is further recommended that marine mammal resources be better utilized and exchanged in inter-community trade.

— Whereas, as noted earlier, the mechanism to ensure sound renewable resource use planning and protection must be comprehensive and involve all relevant publics,

It is recommended that there be established, as an important element of such an improved management scheme, regional caribou management boards, funded by governments and comprised of users and managers, to advise governments on all aspects relating to the wise use of the caribou herds and caribou habitat.

In this regard, we commend the initiative of the Keewatin Wildlife Federation in seeking co-operative management approaches to the caribou resources of their region.

Recommendations in Respect to Research

— Whereas air pollution may have severe long-term negative effects on caribou range,

It is recommended that extensive long-term studies be initiated to determine the nature, extent and effects of present and projected levels of air pollution (especially acid rain) on reindeer and caribou range and hence the future health and productivity of the herds.

— Whereas recent evidence suggests that predation controls caribou population numbers below the carrying capacity of the range and holds recruitment rates at low levels, and

whereas several caribou herds in Canada appear to be declining under current management regimes, and

whereas effective caribou management should provide increased yields for northern users,

It is recommended that an experimental study by conducted on the effects of wolf predation upon caribou population.

It is further recommended that caribou research programs be included in any MAB-related international networks established in the future.

COOPERATIVE RESEARCH

Workshop Report

Chairman: Martin Lewis
York University, Downsview, Ontario

Introduction

Our interpretation of cooperative research has been restricted to cooperation in research between Native peoples and all other organizations and individuals engaged in northern research. We have also restricted ourselves to the Canadian North. We have taken a broad view of research as encompassing scientific activities undertaken by representatives of industry, government, Native organizations, consultants, and universities. The workshop involved a dozen participants representing Native groups, universities and industry, several of whom have personal experience in the field of cooperative research. We first identified problems associated with cooperative research as presently carried out, as well as in a future context. We identified three main areas: funding, research programs and training. Within each of these broad fields we attempted to distinguish between problems encountered by Native and by non-native research organizations. We then attempted to arrive at a set of suggestions or guidelines for solving or alleviating some of the problems. We have also agreed on a recommendation for a pilot project in cooperative research on renewable resources.

We are unanimous in our support of the principle of cooperative research and of the urgency of the need to promote cooperative research projects. We believe that projects of this type should not and will not compromise the quality of northern research. We are convinced that combining the extensive field knowledge of the native peoples with the methods of science will lead to improvement in our understandings of northern renewable resources. This will help to build up a body of knowledge which all can accept and respect. In this way, the dangers inherent in "advocacy" research can be avoided.

Some Current Problems

Funding

— There is an overall lack of funding, particularly for cooperative projects on renewable resources. Projects of this type have tended to receive low priority.

— Inflexibility of existing program often precludes the full participation of Natives and research scientists in joint projects. Difficulties include the orientation of these programs, the research criteria, the insistence on academic qualifications, the securing of funds for consultation and communications with native peoples, including translation into local languages, the delays between submission and funding of proposals. Inadequate provision for the logistic costs of northern research is also a serious problem.

— Existing funding agencies are often unwilling to fund the long-term collection of data which both Natives and non-natives agree is essential in the northern context (see below).

— Suitable funding may be available from a number of unconnected sources which renders it difficult for an individual or group, Native or non-native, to remain informed of resource locations.

Research Programs

— There is an overall inadequacy of basic data on northern renewable resources. Such data are essential to the assessment of resources as well as the accurate prediction and evaluation of impact. This situation is becoming increasingly critical, given the accelerating rate of development in the North. Long-term data sets are particularly critical for the accurate determination of resource levels and for monitoring the impact of development and harvesting on renewable resources in the North where the environment is marginal and unpredictable and animal population changes are often erratic or long-term. There is a serious lack of winter data, resulting from the seasonality of academic research activity.

— Although there is growing recognition of the importance of traditional knowledge, insufficient effort has been made to collect and incorporate these data into the body of scientific knowledge.

— Scientists and Natives alike may be reluctant to concede the incomplete nature of their respective data-bases and understandings.

— Formulation of research programs often fails to take account of Native life-styles, perceptions and needs.

— There is concern among native peoples about the motives of research and the uses to which research data may be put, particularly in the formulation of policies and regulations. Natives also question whether the research is being done to further academic careers, to facilitate development, or out of real concern for the future of the resources.

— Scientists also express the view that they too have little influence over the uses of their data, whether by industrial or government decision-makers.

— The credibility of the results of certain research projects is questioned by native people, particularly where the findings conflict with traidtional knowledge.

— There is concern about the damage inflicted on renewable resources by certain types of research activity, e.g. tagging, aerial surveys and sample collection.

— Insufficient sensitivity has been shown by scientists to the time and energy required of native people for purposes of consultation and data collection.

Training

— There is a lack of knowledge, skills and experience on the part of both Natives and non-natives. Necessary skills are in the scientific, managerial and communication fields. Knowledge and skills are necessary to allow all to better understand and cooperate with one another and to improve the quality of research efforts and management.

— The problems of training for cooperative research in the North are not always recognized. This is reflected in the inappropriateness and inflexibility of existing training programs which fail to take account of the special needs of northern training, and in particular the cultural values and life styles of native people. Two particular problems exist: first, given the short term nature of many research projects, a person who acquires training frequently finds himself with no prospect of long-term regular employment (short-term employment is not training); second, training is often fragmentary without a clear progression towards a desired and identifiable goal. Existing programs are too often oriented towards teaching technical skills and ignore those in science as well as administration, management and communication.

— Universities and colleges, with a few exceptions, are unwilling to formally recognize the training that native people acquire, thereby precluding the possibility of individuals pursuing education at the tertiary level.

Guidelines, Solutions and Recommendations

Solutions to many of the problems we have identified are self-evident and are not commented upon.

Funding

— A coordinated effort should be made to raise additional funding for northern research in general and for cooperative research in particular. Possible sources which should be explored include royalties on industry, tax credits, user fees, private foundations as well as government agencies and research councils. The ACUNS proposal for a Foundation for Northern Research was generally welcomed by the group as a new initiative in this area, although some remained uneasy about the establishment of another bureaucracy.

— If research is to become more responsive to northern concerns, recipients of funds from funding agencies must be given greater discretion to modify their research plans. We suggest particularly the modification of time limits associated with grants to permit the full involvement of Natives in the planning, execution, analysis and publication of research projects, as well as to allow southern researchers to gain experience in the northern setting. Funding agencies must recognize the additional costs involved in cooperative research with northern people. These include the costs of travel, communication, translation and personnel.

— We recommend that a directory of sources of funding for northern research be published and updated at regular intervals. This might become a responsibility of ACUNS.

— A more effective interface between native groups and organizations and southern scientists (particularly those in universities) is essential if research is to become more responsive to northern needs. Such a mechanism would facilitate communication and consultation which are particularly critical during the initial planning stages of research projects. The N.W.T. Science Institute (being proposed by the Department of Indian and Northern Affairs) and the Foundation for Northern Research (proposed by ACUNS) might fill this role, although a small unit (liaison officer and assistant/secretary) situated in the North may be more appropriate at this stage.

— An attempt should be made to incorporate traditional data and interpretations into the formulation, execution and publication of research projects. This might include the application of science to native "hypotheses".

— Where possible, scientists from the south should attempt to conduct their research at times which are convenient to native people and permit their full cooperation.

— In the formulation of research projects more attention should be given to northern native viewpoints and needs. Special consideration should be given to motives, benefits, results and educational content.

— There should be a greater effort aimed at the publication and distribution of research results in forms and ways more suited to northern communities; this refers particularly to publication in native languages.

— We are in general agreement with the MAB Ethical Principles for the Conduct of Research as revised by ACUNS and recommend every effort be made to have them widely distributed and accepted.

Training

— There should be increased use of northern research facilities as bases for training and the establishment at these localities of resident training personnel. This would give research and training a more permanent presence in the North. Mechanisms that should be explored for this purpose include the awarding of northern sabbatical periods and the creation of northern doctoral and post-doctoral fellowships. Holders of the awards would be expected to be resident in the North and devote a proportion of their time to training and related activities. They would also assist in the indentification of local research needs and in the formulation of project proposals as well as participating in the research. They would also receive training and instruction from native people. These suggestions are in close agreement with the "Framework for Science and Research in the North" and development of the "N.W.T. Science Institute" as proposed by the Department of Indian and Northern Affairs.

— Greater attention should be given to the development of northern training programs particularly in scientific and management fields. Continuity and progression of programs are particularly important in this context. There is a need for an educational monitoring/advising service to help northern students bridge the gap between local education/training and higher education at universities and colleges; this service could be provided at the local level by the training personnel at the northern research facilities. Universities have an important role to play in developing more flexible programs for native students.

Recommendation for a Pilot Project

We feel strongly that this Symposium should result in an actual northern-based initiative in the area of cooperative and innovative research on renewable resources in the economy of the North. Therefore, we recommend that a small committee be established and charged with soliciting, selecting and implementing such a project or projects. We recommend further that every organization represented at this Symposium be asked to make a financial contribution within the next two months to a fund to be managed by this committee to

achieve the foregoing objective. Preferably, the project should be multi-disciplinary and incorporate as many as possible of the suggestions and guidelines outlined in this report. Finally, we recommend that this Symposium reconvene upon termination of the project to assess its success and usefulness.

EXPANDING THE SUPPLY OF RENEWABLE RESOURCES

Workshop Report

Chairman: W.W. Mair
Victoria, B.C.

> But I have found that income in kind from hunting, fishing and trapping is a far more important element in the northern economy than we had thought.
>
> Mr. Justice Thomas Berger, 1977

Introduction

At the outset it is important to underline basic principles or thoughts that were explicitly or implicitly agreed upon and hence formed the basis of our discussions and subsequent recommendations.

First, it was clearly felt that the justification for advocating more intensive management was based on socio-economic reasons at the community level. While major resource development projects might generate other forms of revenue, our own position was that community development generates its own priorities for expanding the supply of renewable resources.

A second underlying principle was that even though many possibilities exist to enlarge the supply of renewable resources, priorities have to be established based on the first principle, and consequently local resources should be privileged. Also, expanding the supply of renewable resources relates to local customs and habits and should be achieved in a fashion compatible with local values.

A third concern dealt with the integration of means: it was shown that information as to technical possibilities or evaluation techniques is not properly conveyed to specific communities. Related to this concern was the view that research in regard to renewable resources should be oriented more directly to the management of these resources.

Finally, in view of customary behaviour and preferences of northern peoples, and taking into account the potential for specific and innovative development, native animal and plant resources should be viewed from the perspective of ensuring a greater degree of community self-sufficiency in the north.

Topics Discussed

Our discussions ranged over several subject areas, including, more especially: fur, game, aquatic resources, plant resources, and tourism. We considered the technical feasibility of enhancing the value of the living resources, the need for specific research to improve our ability to increase the supply and value of the available resources, and principles that should apply to renewable resources management schemes.

In considering the technical feasibility of various enhancement strategies, we stress that proposals should take fully into account local preferences and practices, and biophysical characteristics of the immediate environment. Thus, enhancement proposals require not only technical know-how, but an informed appreciation of northern society and environment. In summary, aspects of each subject area discussed included the following.

Fur and game resources. Improvement of harvest level by better timing of trapping, better trapping methods, better pelt preparation and marketing methods, better use of natural population cycles.

Improved habitat management, including preservation and expansion of habitat used by important species; the importance of having information on market trends, and a better understanding of wildlife diseases in furbearers and game animals, and the effects of various pollutants upon northern habitats were identified as areas requiring attention.

Aquatic resources. Areas that do not appear to have received sufficient attention in the past include fish culture techniques, improvements to the logistic and technical means of processing and distributing harvest products, genetic improvement of useful native species, and ways of utilizing some presently unexploited living resources, or parts thereof. The potential for greater utilization of seals (through improved means of distribution more especially) was also a concern.

Plant resources. It was suggested that a critical assessment of the potential nutritional importance of northern plants be made, and the question of "cultivation" of the more useful edible plants be seriously considered.

Tourism. The potential impact of tourism was recognized; however it was concluded that certain types of tourism could be considered as a renewable resource activity which need not be consumptive of the resources upon which it is based.

Some specific conclusions were drawn; these appear below under two headings, namely Management Proposals and Research Proposals.

Management Proposals

General Principles. These three general principles should govern all schemes directed to improved management of northern renewable resources.

- Community-based planning, reflecting local knowledge, priorities and perceived needs should be a basic feature of management. Decisions required to be made at a higher organizational level (e.g., regional or national) should take into account that local-level planning remains the best, if not the only way, to ensure that northern development will respect the realities of the land and its people.
- Internalization of the economy should be an aim, as it leads to diversification of opportunities, and stresses the importance of increasing community autonomy and self-reliance.
- The importance of preserving resource diversity upon which subsistence and further development of northern communities will depend. In this regard we would suggest that the concept of biological/ecological reserves, as developed in the south, does not appear entirely appropriate to the north where the integrative units are of different scale.

Specific Management Proposals. These relate to the improved utilization of resources, either at the harvesting or policy level of application.

— Where the need to underake experimental harvesting programs exists the local communities should be fully involved at all stages of the operation.

— Improvement of inventory, productivity evaluation and population monitoring techniques should result in greater use of local knowledge and manpower resources. Such techniques should be developed to answer specific questions posed at the community level, as well as fulfilling general management needs.

— Where an evaluation of trade-offs between competing resource uses is to be made, it is essential that local users be fully involved in all aspects of the data gathering and decision-making.

— It will be necessary to include the impacts of non-renewable resource developments in evaluations of trade-offs. For example, changes in air and water quality can be expected to have negative impact on, e.g., caribou and fish harvest levels in many instances.

Research Proposals

As noted earlier, it was considered important that research priorities relate directly to management proposals for increasing the supply and/or value of the living resources of the north.

— There is a recognized need to improve technology related to harvesting practices. This implies a close relationship between the individual harvesters and the technical persons; it is expected that the harvesters will have considerable understanding of the most urgent improvements needed, and ways of seeking solutions to the problems.

— It is strongly suggested that there be established a centre (or centres) for arctic renewable resources, whose main activity would be directed toward creating greater northern self-sufficiency of food supply. Studies of fish farming, ranching, and local plant cultivation, as well as promoting the greater uses of native food species would be among the aims of such a centre.

— There is a need to re-establish acceptable levels of research activity in respect to northern renewable resources. It is axiomatic that any intensification of harvesting, or any increase in the demand for the resources, will require a thorough understanding of the productivity and population status of the resource stock. Changes of a profound nature are taking place in the north at this time, and the impacts of these must be under constant investigation.

PLANNING FOR THE FUTURE: MANAGEMENT

Workshop Report

Chairman: John K. Naysmith
Northern Pipeline Agency, Calgary, Alberta

While recognizing that the "North" has several definitions, the experience and interests of participants generally focussed discussion upon the "North of 60" region of Canada and particularly those areas presently the home of man. Those renewable resources which received most attention included fish, wildlife, forests and water. In all cases these were related back to the land-base and man. Philosophies concerning that relationship were considered; two northern residents referred to man's harmony with the land and the view that the earth dictates the nature and extent of man's use.

It was apparent early that altough it is impossible to determine the future, it is important not to ignore the past when considering new directions in renewable resource management.

The workshop, with a view to learning from the past, including centuries of traditional community experience, as well as relatively recent development, turned first to outlining the major problem areas that now exist. Following are statements of these problems in no particular order.

- In current renewable resource management there is much fragmentation in responsibility amongst governments, boards, and agencies.
- A problem of centralization exists, meaning distant decisions are imposed with little or no apparent consultation with local people.
- Institutional management until recently has had as its goal the exploitation of the land and its resources — non-renewable as well as renewable.
- Even the institutional framework now operating has not always succeeded because of failure to enforce regulations and policies.
- As yet we have not, in this country, a comprehensive planning process for northern resource use and management.
- Regardless of the successes or failures of the system by which northern resources are now managed, there are particular and important user groups who view the system as having been imposed and therefore without regard for their local interests.
- Management of renewable resources is bedevilled by differing perceptions of land and land/resource utilization.

The understanding of the principles by which renewable resources are being managed is incomplete and inadequate among nearly all people affected. For example, the experience of local people may have little or no influence upon the technical/scientific approach to knowledge and its use, and conversely the scientific basis for management is an alien approach in the eyes of some users. Furthermore, there seems to be no mandate or recognition that it is important to bring these varied knowledge bases to bear on a common problem. An additional issue in this general area of "communications" is the need to learn more about the impact of resource use, within and outside the area, on those species which

migrate over long distances. In consequence of many of the above points, there is what might be called a "crisis of confidence" within the current system of renewable resource stewardship.

How, then, can we proceed? In attempting to chart a course, the workshop took as common ground the requirement to include the variations in user interest, the variety of resources themselves, and their capacity to remain of value on a renewable basis. But the call for action brought the advice that solutions to most of the listed problems require political action. Some of the problems might be seen as soluble with better communication, improved information or an expanded knowledge base informed by both local and non-local expertize. Attempts, however, to deal with the above problems singly were labelled as merely "tinkering" by those who looked toward political solutions.

After considerable discussion, it was suggested that one of the problems identified, related to the planning process which, if properly addressed, might lead to a solution of several of the other difficulties.

With this in mind, it was generally agreed that to be successful, land-use plans would have to provide for the management of all resources in a way that would meet effectively the overall social, economic and cultural goals of northern society.

Planning technology is not new and several participants believed it could be adapted to northern needs. Although not mentioned in our workshop, it is interesting to note that in the plenary session we heard that this approach is being taken in Finalnd and Sweden.

The planning process has four basic phases:

Phase I: defining the problems and the objectives or goals to be met;

Phase II: concentrates on data analysis and the development of management strategies;

Phase III: the articulation of policy and plan implementation which requires the definition of "how", and "who" does it, the answers to which are politically determined; and

Phase IV: monitoring the effectiveness of the policy and making necessary modifications.

It is important to recognize that in regard to the above process, the plan leads to policy decisions, rather than having a policy in place from which a management plan is developed.

It is fundamental to the success of any planning process in the North that throughout every phase, thorough and effective public involvement takes place.

At this point in the workshop we agreed on several basic issues. The North is the homeland of its native people, and none of us doubted that they must play a key role in the planning and management of future resource use. We further agreed that native land settlements have to be negotiated, and implemented. Further, it was agreed that the future for the North requires that its renewable resources be managed incorporating some form of land-use planning.

What chance is there for the success of the planning approach sketched out above?

One scenario has it that political and economic realities have to be faced — northern development will continue, and probably accelerate, making the need to plan critical. Thus, current management practices must be improved with greater help and involvement of all people in the North.

Some members of the workshop did not accept the inevitability of this scenario and stated why land use planning was likely not to succeed. The lack of trust in existing institutions, regulations and processes, is especially acute among those people who are active on the land and who believe they have the most to lose. How then can they enter the planning process, thereby giving data and advice when they can only expect that at best it would not be used and at worst used to their disadvantage?

As the discussion developed it became apparent that because of some implicit and questionable assumptions certain basic disagreements arose; these assumptions included:

— political and economic realities related to arctic oil and gas developments;
— political evolution in the two territories;
— the inevitability of industrial development and the pressures which that will place upon renewable resources;
— present management institutions and structures must remain in place because there are no viable alternatives.

These disagreements create an atmosphere which makes difficult the resolution of the problems and particularly renders improbable the success of new approaches, such as, e.g., land-use plans.

In all of this the workshop was forced to return to one of the problems that was highlighted early in our discussion, namely the "crisis of confidence" which, so long as it exists, allows little likelihood of progress, and permits only a return to tinkering with the current system. To some participants that crisis will not be overcome until certain political decisions are made and authorities transferred.

Even so, the workshop recognized that moves to restore confidence might be assisted by conscientious efforts to enhance what could be termed the grass roots model for identification of management problems and approaches to their solution. We were given specific examples by one northern resident of cooperation between Inuit hunters and resident game managers in the Keewatin which is both enlarging understanding and changing management conditions. It was enlightening to many participants to learn of the real progress being made between the Government of the Northwest Territories game officials and local people in this respect. Furthermore, it was pointed out that this approach could easily be made to apply throughout the N.W.T. There is yet the possibility of paying deliberate attention to the problems of information and knowledge transfer in both directions, between the institutional managers and those who depend upon the land. This should apply to all user groups or other interested parties in the ongoing evolution of our management responsibilities and methods.

In summary, the workshop discussed in depth many of the fundamental issues affecting renewable resource utilization in the North. Some actions can proceed, such as the

Keewatin experience, but a recognition of the deficiencies now existing should be addressed in future land claim negotiations and in other alterations that may be made to current institutional and legislative structures.

PLANNING FOR THE FUTURE: RESEARCH

Workshop Report

Chairman: H.A. Regier
University of Toronto, Toronto, Ontario

Introduction

During the past centuries many strong interest groups in society have created integrated traditions within applied science that will serve the special interests of those groups. If the interest group is strong enough, it can create an "integrated applied science" which has its own particular scientific jargon, favourite concepts and techniques, educational curriculum, information journals, scientific associations, profession, international symposia, and specialized agency within government. For example, in Canada, within the general field of the natural environment and renewable resources, there are some five or more major "integrated applied sciences", each with a number of varieties. These relate to, e.g., regional planning, agriculture, waste management, renewable resources, and the wilderness environment (as found in the more remote parks).

It is quite feasible now to develop an integrated applied science that would be focussed particularly on the needs and concerns of northern native peoples. It would take hard work, over a decade or two, from a dedicated network of informed native people and committed scientists. Such a northern peoples' science does not now exist in an integrated form. Hence this report in effect envisages a kind of hybrid science in which peoples' concerns and interests are one part and scientists' concepts and methods are the other part. For the time being, a hybrid science may be better than no science.

Mechanism for Consultation

Northern communities are involved in a large number of consultations on projects concerned with research and with social and economic development. These consultations place heavy demands on the time and effort of those involved. There is a need to develop improved mechanisms for consultations; one possibility may be the formation of regionally based "single windows".

Ethical Principles affecting Research in the North

With respect to the conduct of research, the Workshop endorsed the principles expressed in the Canadian MAB Communique No. 6 (1977) entitled "Ethical Principles for the Conduct of Research in the North", as revised recently by ACUNS (see page 260).

We recommend these Principles be widely adopted within Canada and that they be provided to other circumpolar nations for information.

The Circumpolar Nations Arctic Science Policy

The circumpolar nations have been aware of the need to continue to acquire knowledge of the Arctic, but a strong, cohesive policy in support of Arctic science is needed to guide

individual national program efforts in, e.g., resource development, environmental protection, human health, and understanding climatic change.

Canada and the United States in particular demonstrate a lack of appropriate facilities and logistic capabilities to support science in the service of industrial development and cultural and environmental protection in the Arctic region.

Most policies regarding activities in the Arctic have been reactive to special interests and events. At the present time, the greatest potential for significant increases in world oil production exists in the Arctic. The Arctic circumpolar region contains large untapped stores of critical materials, e.g., coal, lead, zinc and antimony, and subarctic seas contain some of the world's oldest and richest commercial fishing grounds. Knowledge of the Arctic will provide each nation with a basis to intelligently evaluate priorities, such as a need to allow environmental degradation as opposed to the desirability of maintaining undisturbed ecosystems. Environmental change impacts upon the social, cultural and economic circumstances of northern peoples; therefore the nature of these impacts must be addressed. Value systems of the peoples of the North must be recognized by the world community, and the world community must be informed and educated as to its own reliance on the Arctic ecosystem and environment. For example, the Arctic polar region (as well as the Antarctic) serves both as an indicator and controller of world climatic change.

The Arctic is itself a large-scale natural laboratory offering man an opportunity to understand such diverse phenomena as, e.g., the aurora of outer space, magnetic fields converging at the poles, the diverse forms of snow, ice, glaciers, and permafrost, a large ice-covered ocean, and a terrestrial and aquatic flora and fauna adapted to low temperatures and minimal light levels for most of the year. This natural laboratory requires physical facilities to carry out the many necessary investigations. The recent closing of the Naval Arctic Research Laboratory at Barrow, Alaska, despite its world-wide scientific participation and recognition, is the direct result of the absence of a U.S. Arctic policy. Similarly, the Arctic Biological Station, operating from Montreal, has become functionless because of a lack of funding for fieldwork, in turn due to the lack of an Arctic policy in Canada.

It is recommended that sustained and substantial funding, at a priority level, be provided to train and facilitate the work of scientists and resource specialists who will address their efforts toward an understanding of ecological and developmental problems of the Arctic, being ever mindful of its people, its resources, and its vulnerability to change.

Long-term Monitoring of Renewable Resources

Renewable resources have been the mainstay of man from his origin until the present, and will be vital to his survival and well-being as long as life persists on this planet. Renewable resources are of particular importance ot the Native peoples, and to many immigrants from the south, who live in circumpolar regions.

All nations now routinely record such physical parameters as temperature, wind, sunshine, rainfall and stream flow, and knowledge of long-term variation in those parameters is essential to planning for development in the North.

Knowledge of long-term variation in the standing crops of northern living resources is

equally vital in order to plan their continued use by inhabitants, and for their protection and maintenance in the face of massive industrial developments.

It is recommended therefore that the circumpolar nations establish a network of biological monitoring stations at which standing crops of indicator species of flora and fauna would be routinely estimated at regular intervals. The kinds of measurements to be made should be determined by an international assembly of ecologists with northern expertise. The program should be closely tied to the UNESCO/MAB system of Biosphere Reserves, and should be expanded as additional reserves are recognized.

Evaluation of the Impacts of Airborne Pollution on Northern Environments

Long-range transported airborne pollution (LRTAP) including heavy metals and various other toxic substances (e.g., SO_x and NO_x acids) carried into the northern regions have been recorded in precipitation. Annual loadings of these substances are relatively low in comparison to southern environments and precipitation levels are also low (20-30 cm per year).

Currently, there is only a low-density network of rainfall chemistry samplings stations in North America (i.e., two north of the Arctic Circle), though a wider network is in existence in the Scandinavian nations.

Unfortunately, very little is known about the effects of these levels of pollution in the terrestrial, aquatic and marine renewable resources of the North.

It is recommended that LRTAP be recognized as a joint problem of all northern nations, requiring careful and immediate study in their Arctic and subarctic regions.

Studies should be initiated to evaluate the impacts of individual LRTAP precipitation events and long term low-level airborne pollution loadings on northern ecosystems.

Finally, there is an urgent need to establish a wider network of rainfall chemistry sampling stations (particularly to monitor individual precipitation events) in northern areas such as the high Arctic, northern Quebec, Labrador, central Keewatin and Mackenzie districts in Canada, and also in Alaska, Greenland and the U.S.S.R.

The Development of a Northern Ecological Data-base

Northern environmental management requires accessibility to up-to-date information of a uniform and reliable nature. Such requirements are not met at the present time. It is also necessary that the potential users of such data-sets agree upon what information is to be assembled, and other technical aspects of the work to be undertaken. It is suggested that as a start, regional distribution characteristics of terrain, soils, vegetation and selected aquatic and marine parameters be systematically assembled. Data sources to be utilized would include published and unpublished reports, tradtional information of northern residents, and new survey results which would be planned using advanced methods, such as remote sensing techniques.

It is recommended therefore that the urgency of this problem be recognized and an early start made to address the identified information needs. In this latter regard, territorial, federal, native and industrial agencies/groups should jointly discuss their present and anticipated future information requirements. Data collected would be published quickly in

reports and as maps at scales of 1:250,000 and 1:1,000,000 on a priority basis according to planning/management needs.

Considerable attention should be given to providing training to managers and potential users of the information, so as to ensure its utilization in the interests of improved northern environmental management practice.

Comparative Ecological Studies

One of the established approaches of science is to compare the behaviour of a particular component or process in a number of different but related systems, and then to seek an explanation of any observed differences between the systems. In this way, the factors that influence the behaviour of a component or process can come to be understood, at least in part.

Comparative ecologists have studied such "systems" as organisms, populations, associations, ecosystems, regions, etc. Many important relationships have been discovered within sets of related systems, with respect to many readily measured variables (e.g., temperature, nutrient levels, etc.)

Freshwater ecologists, for example, have made major progress in developing the comparative approaches of D.S. Rawson with respect to estimating total fish yields from aquatic systems, and of R.A. Vollenweider with respect to nutrient loading. Similarly at the level of population change, some comparative works by S.J. Holt and V.I. Abrosov are being developed further. And at the organism level, F.E.J. Fry's comparative work is being applied widely.

It is now timely to convene a meeting of comparative ecologists with knowledge of northern phenomena to discuss comparative relationships, to test their generality and reliability, to assess their relevance to different locales, to synthesize statements of general understanding, to identify areas of ignorance, and to publish the findings.

In particular such a meeting should address the needs of management of northern renewable resources, e.g., how to improve the assessment of production and harvest potential of given areas, and improve ways of predicting impacts of various land/water use practices on animal populations and their sustaining habitats.

It is recommended therefore, that a major international scientific symposium be convened within the next few years to develop a series of syntheses based on comparative ecological studies, with attention to their relevance to the concerns of the people of the North.

Research into Techniques Necessary for Improved Renewable Resources Management

Several species and stocks, including many of the quantitatively more important ones, are harvested by two or more user groups, but the levels of harvest in many cases are unknown. Nevertheless, such information is necessary for the establishment of permissible levels of take for these stocks and for the allocation of harvests. For such species and stocks which are harvested by more than one group of hunters, it is recommended that a comparative study be made of the appropriate methods useful for estimating levels of harvest and for standardizing appropriate monitoring techniques.

Furthermore, resource users are increasing in number while the resource is constant, or decreasing, in quantity. Systems analysis provides predictions or hypotheses and permits the exploration of management options. Though selected hypotheses or management options must then be tested in the field, the technique is nevertheless efficient in exploring states-of-knowledge and is also a powerful training mechanism in that users interact with the model throughout the exercise.

It is recommended therefore that systems analysis be much more widely used by agencies responsible for making decisions in respect to land use and resource management problems.

Research into Institutional Improvement in Renewable Resource Management

Government agencies are not neutral bodies in the process of policy formulation and implementation. Policies will, in fact, reflect the goals, values, structure and interlinkages that exist between various public and private interest groups. This holds true for a variety of resource management institutions.

Comparative research should be carried out to establish how institutions might better formulate and implement comprehensive renewable resource management policies and programs.

Consequently, *it is recommended* that comparative jurisdictional research be carried out to ascertain existing institutional design, to understand institutional linkages existing between various agencies and non-governmental groups, to ascertain mechanisms whereby various interests maintain access to the policy system, and to better understand the information gathering and assessment techniques in use by management agencies and special interest groups.

To further improve upon existing systems, comparative research should be carried out in other jurisdictions, not only in circumpolar countries, but in those other countries having a well-developed metropolitan/hinterland division (e.g., Australia).

Northern Agricultural Research Program

The establishment of a food economy based on imported resources has resulted in serious nutritional deficiency deleterious to the health of the northern native people. In addition, the high cost of food in northern stores, primarily due to high transportation costs, imposes a tremendous economic burden on the government as well as the northern consumer.

In order to alleviate this growing problem and to increase the degree of food self-sufficiency, a permanent research program in the feasibility of northern agriculture should be promoted. Such a program would include research on wild plants utilized traditionally by native peoples, as well as research on introduced temperate-zone crops, northern cultivating practices, livestock husbandry and selection of crop varieties suitable for northern climates, soils and preferences.

It is recommended that a Canadian Northern Agriculture Institute (similar to the successful Alaskan Agricultural Experiment Station) should be established. This institute would have a permanent research and technical staff and would provide facilities for visiting research-

ers working on independent related projects. It would also become a training centre for innovative uses of renewable resources and northern land utilization.

Research into Health Aspects of Use and Dis-use of Local (Native) Food Resources in the Canadian North

Medical experience as well as systematic population surveys have shown that nutrition status as well as general health tend to suffer (with few exceptions) when northern native populations change their diet from traditional to imported food sources. These findings have prompted research into nutrient content of native foods as well as physical and laboratory examination of various populations deemed at risk. While much has been learned about nutritive value of native food resources, there are many areas left in need of further analysis and clarification.

Much more uneven is our knowledge of local variation in the health consequences of dietary change and the specific nutritional requirements of various northern population groups. To improve our understanding will require continuous monitoring of these populations and groups.

Critical research into health problems of northern residents, and in particular, the health problems of northern native populations related to changes in their nutritional base are of great concern to the native population, the health professions, and informed segments of the public at large. Consequently, *it is recommended* that expansion, rather than reduction, of research efforts addressing such problems is necessary and urgent now and in the foreseeable future.

Northern Environments and the Impact of Tourism

Northern environments can be considered a world precious resource which exceed purely national importance. This does not weaken the sovereignty of the respective possessors, but rather accentuates the responsibility for preservation of these environments. The northernmost (polar) regions are most notably in need of a special status of protection from increasing human impact, since their natural productivity is low and thus the potential for regeneration after damage is minimal under repetitive impact. The living renewable resources (i.e., vegetation, game) are extremely limited, yet the territories are becoming increasingly attractive for recreation; indeed, uncontrolled tourist traffic to the far North is expanding rapidly. In order to control its growth, a well-conceived master plan is necessary, which would direct visitors to the less vulnerable and suitably equipped areas, so as to localize the inevitable impact on the natural environment. These arrangements would protect sensitive areas yet at the same time allow the development of a revenue-producing tourist industry.

It is recommended that a feasibility study leading to identification and classification of ecological regions, designed for protection and early planning of recreational centres in the northern regions, should be undertaken as quickly as possible.

Priority for development of the tourist enterprises should be reserved for northern Native residents.

PROPOSED INTERNATIONAL NETWORKS FOR CO-OPERATION IN NORTHERN SCIENCE

Ad Hoc Working Group Report

Co-chairmen: J.M. Harrison and Edith Carter
Canada Man and the Biosphere Program

Preamble

Following the suggestion of Dr. F. di Castri, Secretary of the International Co-ordinating Council of the Man and the Biosphere Program (MAB) of UNESCO, that the International Symposium on Renewable Resources and the Economy of the North consider the advisability of identifying areas of study of the northern renewable resources question that would benefit from informal international networks for information exchange and research planning, representatives from the various nations attending the Symposium met on two occasions, May 4 and 6, 1981 to discuss the need and feasibility of establishing such networks. The following report on these discussions was prepared by E.F. Roots.

Participants volunteered candidate subjects for inclusion in such networks and noted, that if such networks could be built, they would also further the objectives of MAB.

The candidate subjects were considered in relation to the following criteria:

They should have:

— high relevance to a majority of northern countries;

— high degree of environmental and conservation focus;

— high degree of inter-scientist and inter-institute co-operation.

It was agreed that if such networks were established through or for the Man and the Biosphere Program, they should:

— build upon, and not be in competition with, the professional and international or inter-agency scientific networks that already exist; and

— support, and take full advantage of, international scientific communication and planning mechanisms that are already established, such as the Comité Arctique of the Centre Scientifique de Monaco.

The informal group herewith presents three *recommendations* for consideration by the Symposium, and a number of *candidate research studies* that would benefit from the establishment of international networks.

Recommendation 1: Research and management of circumpolar species

Recognizing that many internationally shared populations of animals are circumpolar

resources which depend on the Arctic marine ecosystem for their survival; and

Recognizing that several Arctic marine areas are threatened or potentially threatened by environmental damage and pollution; and

Recognizing that the International Agreement on the Conservation of Polar Bears and their Habitats (signed in 1973 by Canada, Denmark, Norway, U.S.A. and U.S.S.R.) has resulted in a highly successful, international conservation and management program for that species, and that similar agreements might benefit other species;

The ad hoc working group on co-operation in Arctic science

Recommends that the circumpolar nations formalize the exchange of information on internationally shared selected species that are part of the Arctic marine ecosystem with a view to strengthening international co-operation in research, conservation and management.

Recommendation 2: Arctic Ecological Reserves

Recognizing the important role that the identification and creation of ecological reserves has played in promoting the objectives of the Man and the Biosphere Program;

Aware of the great value that such reserves can have in preserving representative ecosystems for the future, in drawing public and political attention to the value and importance of the varied natural heritage of all parts of the planet, and in serving as sites for present and future research;

Recognizing that Arctic ecosystems and environments are unique and varied, vulnerable to rapid change through the effects of industrial development and other human activities;

Aware that several countries have established or are contemplating the establishment of ecological reserves in Arctic regions, but that there has been, until now, no overall co-ordination between countries with regard to planning ecological reserves in Arctic regions to ensure that the variety of typical Arctic ecosystems is adequately represented or that the research programs carried out on such reserves are co-ordinated and exchanged,

The ad hoc working group on co-operation in Arctic science

Recommends that a circumpolar network of ecological reserves, in the Arctic regions of all northern countries, be identified and established as a coherent subprogram of the Man and the Biosphere Program of ecological reserves. Such a network should encompass and represent the full variety of major Arctic ecosystems;

Recommends that there be established and implemented comparable or co-ordinated research programs designed with international co-operation, in the Arctic ecological reserves;

Requests the International MAB Secretariat to obtain from its register of sites and programs of ecological reserves in all countries:

— a list of ecological reserves in the boreal forests and Arctic regions;

— a list of research programs proposed or underway for these northern and Arctic reserves;

and to make these lists available to the MAB Committees of all circumpolar countries as the first step in the planning of an international network of Arctic ecological reserves and co-ordinated research programs.

Recommendation 3: Boreal Forests

Recognizing that despite the critical role that boreal forests play in all biological and human activities in subarctic and Arctic regions, and despite numerous specialist studies of different aspects of the northern forest ecosystem, comprehensive reviews of the state of knowledge of boreal forests have been very few;

Aware that for a number of reasons the northern edge of the boreal forest was curiously neglected in the inter-country planning of the International Biological Program, despite it being an area where scientific and regional development problems are shared by many northern countries and where therefore there would be much to gain from co-operative planning and mutual sharing of research results;

The ad hoc working group on co-operation in Arctic science

Recommends that an international conference on the problems of boreal forests be considered by appropriate agencies under MAB encouragement to:

— identify major problems in the utilization, preservation, and enhancement of the quality of northern forests;
— review the state of knowledge of the above problems, and of the future trends and resource or environmental implications if present management practices or neglect continue;
— identify priority areas for research and management attention to assure future productivity of northern forests and their ecosystems.

CANDIDATE PROJECTS THAT MAY BENEFIT FROM AN "INTERNATIONAL NETWORK"

Social and Economic Studies

Land use — "North"

This study is already a Swedish MAB project, designed to investigate the socio-economic and biological effects of present land use practices in a sub-arctic area and the present and potential influences of major and subtly superimposed changes in land use.

There would be value in undertaking similar studies in selected areas in other circumpolar countries, co-ordinated by an informal international network of specialists.

Rural village settlement and use of local natural resources in boreal areas

This study, already started in Finland, is aimed at the development of resource use models that can relate settlement activity and human demand to biological characteristics and natural productive capacity.

There would be value in undertaking similar or comparative studies, under MAB auspices, in other circumpolar countries, co-ordinated by an informal international network of specialists, or by co-operation between institutions.

The use of renewable energy resources to meet local and regional needs in northern and arctic regions

Because of the small size and dispersed nature of the market for energy in northern regions, little attention has been paid to developing the technologies or production and distribution systems to meet the specific energy needs of northern areas, particularly rural northern areas. Yet these are areas where energy costs are especially high and rapidly escalating, and where energy needs are particularly acute.

Considerable potential for development and use of renewable energy resources, on a small scale and having wide application, exists in many northern areas, yet systematic examination and realization of this potential is not being undertaken as part of the national energy plans of northern countries or by private industry. Some individual studies however, are under way in several northern countries.

It is recommended that a co-ordinated study of the present and potential use of renewable energy resources in northern areas be undertaken under MAB auspices, co-ordinated by an international network. The work should be focussed on the needs and the opportunities of small communities in rural settings in northern regions.

MANAGEMENT OF ECONOMICALLY IMPORTANT SPECIES

Comprehensive approach to management of caribou

Caribou are an economically and socially important resource in nearly all north polar countries. Many specific aspects of their biology, population, behaviour and utilization have had extensive specialist study. However, the major problems of caribou management cannot be solved by individual specialist groups, but require the co-operation and interchange of information between many groups that are not ordinarily in contact with one another. There is also much to be gained by systematic exchange of knowledge and experience between all countries with caribou populations.

It is recommended that a program of co-operation and exchange concerning caribou management be set up, to include:

Biologists (including botanists)
Forestry professionals

Local residents
Policy makers and advisers
Social scientists
Technologists
Veterinarians

These groups would form a loose international network on caribou management under the auspices of MAB.

BROAD STUDIES OF ECOSYSTEMS OR ENVIRONMENT

The structure, function and productivity of northern ecosystems

There have been many general descriptive studies of specific elements of northern ecosystems, and some detailed studies (e.g. under the International Biological Program) of selected representative ecosystems in northern and Arctic regions. It is felt that it is now timely and appropriate for this descriptive and specialized knowledge, of separate regions in different countries, to be assembled and compared, as a MAB project, to provide a basis for general characterization of the structure and function of boreal ecosystems. Such an assembled body of knowledge would be relevant to assessment of human use or disturbance of the ecosystem. Particular attention should be paid to the productivity of northern ecosystems, and the factors that control or change productivity. It may be useful to sub-divide northern ecosystems into a few broad divisions, e.g.:

— boreal forest ecosystems;
— taiga ecosystems;
— mountain and high Arctic tundra ecosystems;
— Arctic coastal marine ecosystems.

It is suggested that a committee or small conference be organized under MAB to consider the usefulness and feasibility of broad studies or reviews of this topic.

Biological response to changes in climate and ocean characteristics in Arctic regions

All natural and human activities in northern regions are strongly influenced by northern climate, and very sensitive to changes in climate. Various studies are under way, co-ordinated through the Polar Sub-program of the World Climate Research Program (WMO-ICSU), to determine the physical factors influencing climatic stability in the polar regions and to examine the characteristics and physically feasible range of climate variations. These studies will give knowledge of the possible changes in climatic and meteorological parameters in northern and Arctic regions, and while they will not likely be able to predict the future climate, will give much better information than is presently available about the possible severity and rate of future climate changes. At the same time, a number of studies proposed or co-ordinated by the ICSU Scientific Committee on Oceanic Research (SCOR) will provide information on the rate and magnitude of physical changes in the ocean and on the transfer of heat by the oceans to northern regions. This information is essential to a proper understanding of climate change and its significance.

However, neither the WCRP nor the SCOR studies will provide information on the biological response to changes in the atmospheric or oceanographic climate. Yet it is

changes in biological productivity, on both terrestrial and marine areas, and changes in species relationships, shifts of natural populations, etc., that will be among the most important effects of climate change from a socio-economic viewpoint. Knowledge of this response is vital to realistic long-term planning, policy development and responsible investment decisions in Arctic regions.

It is recommended that an international study be undertaken, under MAB auspices, to bring together present knowledge of the biological response to climate change in northern regions, including a realistic appraisal of the limitations of that knowledge, and to propose a co-ordinated study to fill gaps in that knowledge. The areas to be considered would include evidence of changes or sensitivity of individual species, inter-species relationships, population responses, habitat changes, etc. to a range of feasible or possible changes in weather extremes, climate norms and climatic instabilities, and oceanic characteristics.

The difficulties of such a study should not be underestimated, for the extreme complexity and individual variability of biological response, and the difficulty in obtaining rigorous and reproducible data on living systems make the basically descriptive and process-oriented approach to biological knowledge difficult to reconcile with the statistical and modelling-oriented approach that is currently most successful in oceanographic and climate studies. Yet it is precisely because of these difficulties, and the resultant temptation either to draw unwarranted conclusions or to neglect to take into account the relationship between climate and biology in northern regions, that a careful and critical study, on an international basis, should be undertaken in this area.

Such a study should be planned by a small group that would include terrestrial biologists, climatologists, physical and biological oceanographers. It would be important, at least at the outset, that the terrestrial and marine responses and their inter-relation be considered as part of a single study program.

Primary productivity in the Arctic Ocean

Knowledge of the primary productivity of the Arctic Ocean is fundamental to an understanding of productivity in the marine environment, the abundance and capacity for recovery or enhancement of marine species useful to humans, for assessment of changes that could be caused by human activity and the effectiveness of measures that could be taken to protect the Arctic marine ecosystem. Present information of the primary productivity of the Arctic Ocean waters, while considerable, could be improved through international co-operation and co-ordination in studies of three specific areas that may be significant to our understanding of the stability of the ecosystem and its response to perturbations:

— A study of the nutrient contributions of selected major river systems of North America and Eurasia draining into the Arctic Ocean. Knowledge of the nutrients being delivered by, for example, the Colville River in Alaska, the Mackenzie River in Canada, and the Kolyma or Lena rivers in Siberia, would provide a basis for estimating the importance of river-supplied materials in determining the productivity of Arctic marine ecosystems. Determination of the importance of this contribution would be very valuable in assessing, for example, the extent and significance of water pollution from Arctic industrial developments in the future, or in estimating the rate and pattern of recovery and replenishment of a polluted or contaminated coastal marine environment.

— Recent discoveries of significant beds of kelp in coastal areas of the Beaufort Sea have indicated the importance of a circumpolar survey of the distribution and extent of macro-algae around the Arctic Ocean. This information would not only increase the understanding of variations in the rate and pattern of primary productivity in the Arctic Ocean, but would provide information on feeding grounds and schedules of movement of economic Arctic marine species, and it would help identify critical areas for environmental protection.

  It is suggested that a network of specialists from the USSR, Alaska and Canada, later expanded to include Norway and Greenland, be created under MAB to plan and organize such a survey.

— The biota that grow on the underside of sea ice are an important element of the Arctic marine ecosystem. Not only do they constitute a significant proportion of the biological production (estimated to be between five per cent and 30 per cent) in certain parts of the Arctic Ocean, but their abundance in some areas, and their release during periods of ice break-up or melting, are critical factors in the Arctic marine food chain and the localization of Arctic fishes and marine mammals at certain times of the year. Thus an understanding of the occurrence and abundance of sub-ice biota, and of the factors that control their stability or fluctuations, is very important to the management and protection of Arctic marine species used by man.

  Studies of the sub-ice biota, and reliable surveys of its abundance or regional distribution at all times of the year, are very difficult to carry out, both logistically and scientifically. Consequently present information is fragmentary. It is suggested that a co-ordinated international program to address this subject be organized under MAB auspices.

In addition to these areas of special attention, there is need for:

— An international review of the methods for determining primary productivity in ice-covered waters. An international group of specialists, organized by MAB, possibly in cooperation with SCOR, should be convened for this purpose, with a view to recommending co-ordination or the establishment of internationally accepted criteria if that were found to be needed.

Biological effects of fire in northern forests

The effects on the northern forest ecosystem of forest fires or controlled burning have been little studied. The results of studies of fires in more temperate forests may have little relevance to boreal forests or taiga. Information on the biological effects of northern forest fires, of the duration of such effects, and of the sequence and pattern of biological recovery is important to good forest and northern ecosystem management because:

— The cost of suppression of northern forest fires is very high, and scientifically sound estimates of biological damage will help provide a basis for decisions on fire prevention and fire-fighting expenditures and priorities.
— Deliberate and controlled forest or tundra fires may be a means of fur management, clearing for other purposes, forest species control, etc.; therefore the long-term or ecosystem effects of such techniques should be fully understood.

It is suggested that a network of northern forest specialists from several Arctic countries be convened to consider the state of knowledge and desirability of co-ordinated or co-operative research in this area.

STUDIES OF SPECIFIC ELEMENTS OF THE BIOSPHERE

The Adaptation of Animals to Arctic Conditions

Specialized studies of the physiological and biological characteristics of animals that have adapted to the distinctive conditions of the northern environment have been carried out in many of the circumpolar countries. It is suggested that it would be useful for an international group, organized under the auspices of MAB, to bring together available knowledge and to propose or co-ordinate research on the processes of adaptation of animals to the Arctic environment. Attention should be focussed first on the adaptation of mammals, because these are the ones most likely to be of direct importance to man. Knowledge of the processes and limitations of adaptation will be directly useful to the management of wild and domesticated animals in the Arctic, to an understanding of the effects of extreme weather, climatic change, etc., and taking the appropriate management or economic measures. Later studies would investigate the adaptation of birds and other animal groups.

Characteristics of the Adaptation of Animal Populations to Arctic Conditions

The processes by which a population or a community adapts to imposed environmental stresses or changes include the physiological adaptation of individuals, as well as other responses occurring at the population or community level. Genetic changes can only take place in a population; learned group responses or changes in behaviour or diet preferences can only have survival value for a species or a population if developed as a new norm for a group. Because Arctic animal populations are characteristically stressed by their physical environment, a study of the adaptation of populations or communities to those stresses will not only provide useful information on the workings of the northern ecosystem, but may provide useful insight into the processes of evolutionary change and behaviour.

It is suggested that an international group, organized under the auspices of MAB, consider the available information on the adaptation of animal populations and communities to northern environmental conditions, including:

- characteristics of genetic selection and change in relation to identified parameters of the northern environment;
- the processes of adaptive physiological change, as evidenced in populations and groups;
- the processes of adaptive or learned behavioural change in response to Arctic conditions.

Such a group might identify research programs or critical observations to be made at intervals to contribute to a long-term study of this phenomenon.

The Adaptations of Humans to Arctic Conditions

As development of the northern region proceeds and human populations increase, it is of ever greater importance that the effect of northern environmental conditions on long-term

resident and on transient humans is fully understood. There have been many studies of Arctic health questions, notably co-ordinated and reviewed by the periodic Circumpolar Conferences on Arctic Health; but it is felt that it would be useful to conduct an international review of the knowledge of the process of adaptation to northern environmental conditions, and to propose co-ordinated future research. Such review and planning should be organized by MAB in consultation with the Committee for the Circumpolar Conference on Arctic Health.

Selected sub-topics under this review could include, among others:
- processes and limits of physiological adaptation, and identification of the specific environmental or other stresses to which the adaptation is a response;
- behavioural and psychological adaptation of humans in different social and occupational situations;
- nutritional effects and the role of nutrition in adaptation.

Arctic Vector Diseases

The Arctic regions, like other parts of the world, contain a number of diseases or parasites whose life processes pass through two or more species, and which therefore are specially adapted to the Arctic ecosystem. Several of these diseases or parasites affect humans or species of animals valuable to man, and thus an understanding of the diseases and their relations to the Arctic ecosystem is of direct socio-economic importance.

It is suggested that this is a particularly important and relevant area for study by MAB. It is proposed that an international research program be established to study the pattern and distribution of the nematode worm *Anisakis*, responsible for the disease *Anisakiasis*, which affects humans and whales. The worm uses salmon and herring as intermediate hosts en route to the mammals (whales and humans). The extent of worm infestation in salmon and herring in subarctic waters is not known.

It is proposed that a network of U.S. and Canadian scientists be established under MAB to investigate this disease and its presence in the ecosystem. The study could then extend to the USSR and the Scandinavian countries.

TECHNIQUES, CRITERIA, ETC.

Biological Monitoring of Environmental Change

Because of the geographical extent of the Arctic regions, the vast distances between human settlements, and hence the great cost of systematic, detailed and repeated scientific surveys, and also because of the slow rate of biological growth, monitoring or measurement of changes in the Arctic environment or biological systems is very difficult and expensive. The use of the presence or abundance of selected species, or of critical biological community mixes, as indicators or integrators of a number of environmental changes over time, holds great promise. The information that could be given by such indicators or proxy monitors could be very valuable and indeed essential to assessments of the success of environmental protection, measures to provide warnings of impending critical conditions or the need for policy or protective action, or for economic planning and scheduling in the wise use of renewable resources. However, little research has been done

to identify biological monitors specially suitable for Arctic regions, or to determine their environmental significance.

It is suggested that a MAB international network be created to review the state of knowledge regarding biological indicators of environmental conditions in Arctic regions, and to recommend research or experimental programs which could be undertaken in two or more Arctic countries, to investigate and improve the usefulness and "calibration" of such indicators in various situations where environmental conditions and changes could be observed and measured.

Criteria for Stability and Resilience of Components of Northern Ecosystems

Because Arctic ecosystems are highly stressed by their physical environment, and because there are a relatively small number of inter-species relationships compared with those of ecosystems in lower latitudes, variations in behaviour of a single major species can have important effects on the biosystems as a whole. Different species have different degrees of stability and response — some are inherently unstable, and shift markedly from one population leve' or mode of behaviour to another when certain critical external conditions are reached; others are much more stable, tending to return to an original condition after stress, or to oscillate or cycle predictably within limits. It is important for many aspects of renewable resource management and for effective conservation of important species, to be able to describe and relate the degrees of stability and resilience of selected species populations or inter-species relationships. Criteria for description of these relationships have not been well developed for Arctic or northern regions.

It is suggested that an international group be set up, under MAB auspices, to consider and devise criteria for observation and description of the changes in growth or population of key species or groups of species (forage plants, economic animals, aquatic insects, etc.) which would provide indication of the relative stability, or states of change, of selected components of the Arctic terrestrial and aquatic ecosystem. Such criteria should, where possible, be based on observations of identifiable characteristics that are amenable to automatic or mechanized technologies, such as remote sensing, biochemical sampling, etc., so that large areas or critical areas can be repeatedly sampled over extended periods of time.

CAN WE TALK OUR WAY INTO A BETTER NORTHERN RESOURCE MANAGEMENT AND ECONOMY?

E.F. Roots
Environment Canada, Ottawa, Ontario

We are coming to the end of three-and-a-half days of vigorous discussion. We have listened to the ideas of others, and had a chance to say what we wished on subjects that mean a lot to each of us. We have come here at considerable expense to the taxpayer and to some industries, and in some cases at our own expense. We have had the benefits of the hard work and careful planning by the organizers of the meeting and the managers and staff of the Banff Centre, and have now come to the end of a smoothly run, enjoyable and thoughtful symposium in this magnificent setting.

We have heard some stimulating talks, and also listened to some pretty boring ones. We have been encouraged to think about the future, and to consider the mistakes and experiences of the past. We have been challenged to question our own value systems and to recognize that others have different values that may be just as worthy as our own, although we may not share them. We have been told to use common sense and be practical, and also been encouraged to state our prejudices, beliefs and gut feelings as important things in their own right. We have said we should be realistic, but idealistic — or maybe it is the other way around. We have told each other not to be afraid of change, but even more, not to destroy or overlook the real values that lie in our histories and own different heritages, even though almost everyone here knows that he or she is to some degree a living example of the fear of change and the disregard of our heritage. And of course, we have had a good time renewing old acquaintances and making new ones.

All of this has been very good for us, individually and collectively. Has it been good for achieving a better harmony or integration between renewable resources and the economy of the North? If a symposium is literally "a drinking together", have we drunk together, of each other's knowledge, experiences and problems, of each other's spirit as well as the bartender's spirits, to a purpose that has served the objectives that brought us here from eight countries? When we go home, will the problems that confront each of us be more amenable to solution, will we be able to make better progress, because there has been this symposium than if it had not been held? We all know that important changes or improvements rarely come suddenly, and are seldom the result of a single cause or event; but unless our four days of talk have helped our common cause, was the meeting worth it? In these last few minutes let's ask ourselves what we have done and not done, and try to assess whether it has been useful. I can of course, give you only a personal viewpoint, which is still being formed this morning as the meeting draws to a close; but perhaps each of us can think about these questions more as we go back to our separate responsibilities and try to use, to the best advantage whatever we have achieved at this symposium.

What did we do?

Here are some things that it seems to me we have done:

— We identified some *major areas of shared concerns* regarding renewable resources

and the economy of northern regions. From the generalization widely accepted before the meeting, that the values that renewable resources bring to northern society are poorly represented in most accounting of northern economies, we progressed to some specific identification of what are the kinds of values living resources provide to northern society, and examples of some actual problems or methods of accounting for such values.

— We made an honest start at *identifying and discussing resource management problems from the points of view of different legitimate interests*. I think we began by the second day to achieve a degree of sophistication that has gone beyond the simplistic impulse to try to reduce everything, including intangibles, to a common dollar base, and freed ourselves of the restraint which assumes that economic management requires value systems to be comparable. A good feature of our discussions, if not of the presented papers, was that we found we could do this not in abstract or theory, but in terms of real things — caribou meat, jobs, family tradition, cash. But we did not get far enough for our ideas to be of much use to a traditional economist.

— We did some thinking (but not much) of *the ways that scientific knowledge can be applied to resource evaluation and management;* and we also aired a healthy skepticism of the value or relevance of much scientific data or conclusions.

— We got a wide spectrum of people to acknowledge that *resource needs that arise out of tradition or custom are just as real as needs that rise from physical or economic want*, and that these too have a claim on management policy and financial investment. I don't think, however that we made any real progress in finding ways to express the claims that these needs have on policy, other than the time-honoured evasion that every need or pressure for action that is not demonstrably physical or commercially economic must be "political" and thus, not subject to rational analysis. This of course, is a cop-out, and is nonsense; economic and physical needs are just as "political" as the needs based on tradition or custom, and are just as easily ignored, to the future peril of society and resources and the political system itself, as any other needs.

— And we made a number of statements of intention, or of concern, or philosophy, about the *rights and priorities of northern peoples* and their relation to the policies and actions of governments and southern interests. Everyone here will have a different opinion about which of these, or whether any of them, were any good.

Out of all that, we have agreed on a lot of recommendations and suggestions, mostly for other people to carry out.

What general conclusions emerged from the symposium?

Lying behind the specific statements and recommendations of the workshop reports, it seems to me that we reached several general conclusions:

— We agreed that, on the average and by a large number of criteria, both the *social systems and the natural ecological systems in northern regions are more vulnerable to change* than their counterpart systems in temperate latitudes. This does not mean that they are more delicate, or easily destroyed; but it does mean that, in comparison with the norms of human experience and biological behaviour in most of the rest of

the world, internal or externally imposed forces on northern systems tend to result in larger changes and consequences. This comparative vulnerability of the North is shared by all polar nations. As both renewable resources, of all kinds, and the northern economy are directly dependent on the stability or changeability of ecological and social systems, this vulnerability to change must be acknowledged and allowed for in both social and resource development policies if the policies are to have the desired results.

— We took a fairly consistent position that, for effective and in the long-run economically successful management of natural resources and human activities in the North, *there must be greater priority of decision-making initiative and input at the local community level with regard to resources control and management* than there is now, in almost all polar countries. By and large, I think, the symposium went further: there were many statements, not challenged by others, which pointed out that for a variety of reasons having to do with the environment, economy, and history, the degree of local initiative and control of resource management and social development has to be relatively greater in the North than in the southern parts of northern nations, instead of less as it usually is today. This is a most difficult and complex conclusion to come to, despite the fact that many of our speakers saw it as a simple or black-and-white issue. It certainly means different things to different participants. But there is no doubt that something along these lines is one of the main conclusions that lies behind many of our recommendations.

The consequences of this conclusion are enormous. I would like to think that collectively and individually we are sophisticated enough to be aware of the many problems raised by such an idea — problems to which no answers were brought forth at this meeting. We did not face issues such as how can a locally-controlled economic system continue to reap material benefits from and interact with an economic system that is national/international in scope without becoming a ward of that larger system; or, how can local management deal adequately with a migratory resource? Many of these kinds of problems will no doubt face us more clearly when we get home. But as a group, it seems, we concluded that with all the difficulties, the problems which arise when there is too little local autonomy and control were greater than the problems that come from greater local control. This is an area where each of us will want to do a lot of thinking in the next few months about the actions needed to put our recommendations into practice. We agreed at least on one thing: — that it is important and urgent for northerners to achieve the change from being puppets on strings to becoming full players in the game. But the awkward thing, which several people pointed out in the last few days, is that as soon as this change takes place, the game is no longer on a small stage or in the backyard of the North — it becomes a national or world-wide game, and then it is hard to find the local players or to define their roles.

— We agreed that, to relate renewable resources to the economy of the North, *the only sensible course was to take a broad view of the economy, and not restrict it to the commercial or cash economy*. We did not do very well at defining what that broad economy was, but it had elements of perceived social benefit, harmonization of lifestyle with the nature and distributions of total resources, and perhaps above all, freedom from the constraint of discounting future benefits. We seemed to be edging toward a conclusion that, in the North, the state of the total economy would be determined by the health of the total ecosystem, including its human component, but

we never found how to get that far. So perhaps all we really concluded in this area was that: a) conventional accounting systems give only a partial and unsatisfactory picture of the value of northern resources and the success or failure in managing them, and b) the test of good resource management in the North is to compare the actual with the optimum in each instance, and it may not be useful to try to compare total bottom-line productivity or to look for common criteria of performance.

— We concluded that none of us, *neither the political people, communities, or the private sector had yet found ways of addressing social realities with the same confidence and credibility that we can address physical realities*. With regard to the policy action needed, we all are still more comfortable when talking about potential oil reserves and acknowledging that the estimate may be in error a hundred-fold either way, than we are about discussing the evidence for or causes of the increase of family disorientation and break-up that is taking place before our eyes.The ove:whelming bulk of our research and study in the North is on physical or non-social subjects. The result is that, although most of our really difficult problems in the North have to do with people, the greatest growth of knowledge and experience is in areas not dealing directly with people questions. The realization of this paradox, and the policy dilemma it poses has been, it seems to me, another of the obvious but important conclusions of this symposium.

— A predictable conclusion of the symposium has been that *we need more knowledge and understanding of northern resources and their values*. Many of our recommendations point this out. But, so it seems to me, we went a bit farther than to sound the traditional call for more research. We tried to make an effort to show that although to increase our understanding, we need good science, good science alone is not enough. To build our knowledge of the *value* of northern resources we have to find a way of interpreting scientific results in terms of their cultural, nutritional, psychological and political significance. This, of course, is what the Man and the Biosphere Program is all about, and sometimes it seemed to me that it took a tremendous amount of beating about the bush for us to realize that what we were talking about was the definition of study of Man and the Northern Biosphere. And my personal conclusion from all this is that no northern country seems yet to have shown itself to be very good at taking the results of researches in the biological or physical sciences in the North and evaluating them in terms of social significance. *The MAB approach in the North is very badly needed*. Despite the fact that the MAB idea has been endorsed by most northern countries for more than a decade, it has not been satisfactorily applied to northern problems.

— A very important conclusion concerns *the value of international sharing of knowledge and experience on northern resources and socio-economic questions*. The sharing of not only research results but of goals, and of problems encountered between all north polar nations, has clearly been one of the highlights of the past four days, and its value is only beginning. With good fortune, and further work by all of us, this symposium may also mark the start of sharing and collaboration in planning our future work.

What we did not discuss

Despite the wide range of topics and workshop subjects, and the variety of viewpoints expressed by such a diverse group of participants, there are a few areas which, although

they seem to me to be central to the whole theme of the symposium, to my surprise, I did not hear mentioned at all.

— We did not talk about *human renewable resources, and the implication of the changes in the human resource*. Aside from a couple of passing references to population growth in some of the introductory papers, there was no discussion of human population studies and projections or causes of demographic changes as they relate to resource demand and supply. I did not hear any discussion of the degree of over-population of the North, despite the fact that in terms of the people being able to make a good living with the resources available to them, their northernmost regions are the most over-populated parts of most circumpolar countries. I am not, at this late stage in our meeting, suggesting what we should have concluded in this regard; but it is surprising that we avoided discussing a matter clearly so central to our main theme.

— There was surprisingly little discussion of the *use of advanced techniques for identification and analysis of bio-ecological and socio-economic problems*. The symposium probably has a skepticism about new-fangled methods of study and decision-making that replace hard-won experience and observation with models and test measurements, and which substitute computer calculations for common sense. From my bias, such a skepticism is healthy. Several of the workshops, of course, did call for use of sophisticated techniques of systems analysis for resource behavioural study, comprehensive land-use planning, use of indicator species or specialized monitoring techniques, etc. But this was mentioned mostly in the name of science. We did not really seem to admit, or consider, that with all their shortcomings and tendencies to give answers that may look precise but may be quite wrong, these new techniques enable a tremendous amount more information to be handled and related than ever before; they may show the causes and relative effects of influences that at first look obscure or which might be overlooked; and they force the setting down of assumptions and relationships for others to see and comment on. All of these characteristics make some of the new techniques very appropriate to social and resource questions and possibly applicable to the description of whatever we mean by the larger economy of a region.

  It seems to me that we missed a good chance to discuss the opportunities that, for example, northern communities have to use modern data-gathering and analysis techniques and get answers ahead of the southern specialists on questions of importance to the North. By taking the initiative with use of advanced techniques on problems which they define themselves, northerners would be able to meet southern policy-makers and developers on their own ground, in terms that southern economists and policy analysts can understand and be convinced by, and so have the community orientations and values become a part of the decision system, instead of, as often now, something impacted on from the outside. We should perhaps have talked about the potential for turning the tables though the use of sophisticated techniques *by* the North, not by southerners *on* the problems of the North. MAB activities in other parts of the world — e.g. studies in rural Austria — might have been able to help us here.

— We did not discuss, in any serious way, *the problem that is imposed by the general acceptance or expectation that southern-style economic and social development is desireable for the North* — in other words that development is "a good thing", even though its excesses and injustices may have to be managed. True, some members among us were strongly outspoken against such development, and almost all of us,

in one way or another, saw certain undesireable effects resulting from the northward movement of southern-based systems as a major cause of the problems that have brought us here. But we did not face squarely the question of whether the acceptance of these changes as being good, or not good, constitutes a problem in itself. We have ample evidence, for example, that industrial planners, and most politicians, believe without question that southern-style economic and institutional development is a good thing. Most southerners probably take it for granted that a person who has colour television and mail delivered every day is better off than a person who does not have these things, and if it was necessary to forego some freedoms or previous habits to be able to have such benefits — well, everyone has to pay a price for the good things of life. There is evidence, also, that some northerners also agree, consciously or unconsciously with this point of view; while others agree only partially or not at all.

I wish we had discussed, at this symposium, the influence that different degrees of acceptance of the desireability, as well as perhaps the inevitability, of southern-style economic and social systems have on the question of management of renewable resources and the economy of the North. I will try not to judge whether it is a good or a bad thing to accept these changes as desireable; but there are at least two major consequences that seem to me to be related to how broadly these ideas are accepted. The first is that if most people simply assume that, with all its problems, the introduction of such systems is "a good thing", then the idea of such development becomes a self-fulfilling concept. The second is that such acceptance probably increases both the dependence of the North on the south and the puppet-on-a-string syndrome of northern decision-making; it increases the reliance on centralized governments and industry leaders for important initiatives, for to an important degree the real strength behind southern policies and thrusts is not dollars or laws but the widespread taken-for-granted assumption that on balance, all these changes are for the common good. These questions were very much part of our problems and concerns at this symposium, but we never discussed them directly.

— Another area very central to the main topic of our symposium, but which I don't think we really tackled, was *the implications that changes in the organization of resource production, or the introduction of resource substitutes, have for causing shifts of social structure in the North*. Students of culture, social scientists, and maybe even economists, often refer to the effects that a change of technology — say, the introduction of the rifle — have had on the social structure of northern society. But in the modern context, and in the light of our discussions at this symposium it would perhaps have been more pertinent to consider the effects, on northern social systems, of current and pending changes in organization of resource production or in local use of resources. We had many examples of developments that give us food for thought along these lines. The successful commercial herding of reindeer on the Tuktoyaktuk peninsula with the development of a local enterprise to supply markets in southern Canada and Asia, the success of the Alaskan Eskimo Whaling Commission in dealing with the International Whaling Commission on bowhead problems, the extensive study of caribou population fluctuations in west Greenland and its implications for caribou range management and sustained or cyclic harvesting, the evolution in personal taste and preference as beef replaces seal meat in the family diet; — these and other examples mark profound changes, that are probably irreversible, in the attitude of local people to the management of local resources and the way they must organize themselves to exploit and preserve them. Such changes will undoubtedly

bring about changes in the local social structure, in addition to, and probably superimposed on, changes brought about by government policy, standardized education, or the progressive introduction of modern technologies and a wage economy. Certainly, these changes in themselves have strongly altered the local meaning of such concepts as "living off the land", "community identity", and perhaps the difference between being a northern resident and being a native northerner. Our symposium might have done well to have considered the effect that changes in resource management have had on the social structure of northern communities, for the conclusions we reached could well have been useful to resource people who tend to ignore the social implications of their findings and to the social policy people who tend to overlook the realities of changing use of resources.

Some Worries

Despite the fact that we have covered a lot of ground in the past four days, and in some cases reached a surprising degree of agreement between people with different priorities and backgrounds, there are a number of areas where it seems to me we perhaps could have made progress but in fact made little or no headway; and where are now about to go our separate ways leaving some major problems of our topic as intractible as ever. Let me mention some of these areas, as they occur to me. Each of you could compile a similar list, with different items.

Traditional knowledge vs. scientific knowledge

We did not do at all well in building workable bridges between the traditional knowledge of resources and the knowledge that comes from scientific study of resources. We all know, and many even admitted, that each area of knowledge has much to teach the other. But here, as elsewhere, we tended to fall into black-or-white positions which only good manners kept from becoming confrontation. The lack of mutual appreciation and understanding in this area can only mean a loss for the North.

The fallacy of change

There was far too much emphasis on defence against change — both by those who were trying to use it to preserve traditional values against the onslaught of new pressures and who found themselves falling into a hold-the-line position; and by those who saw a need to break it down in order to promote the acceptance of new economic development and who saw in others an unrealistic "back up to the last century" attitude. What seemed to be lacking in our discussions was an open realization that traditional cultures and values are themselves dynamic and that what we really should be striving for is neither simple acceptance of imposed new values and economies nor a static preservation of yesterday, but instead a positive steering of a strong but distinctive society toward a future that recognizes and builds upon its past and makes use of present opportunities. We did not have the nerve, or the optimism, to talk in those terms. I am afraid that, if we keep phrasing our concerns in terms of defence against changes or the desireability of change, events are simply going to pass us by.

Responsibilities of northerners

To me, one of the disappointments of this symposium was that it apparently did little to break down the all-too-common reluctance of northern interests, and especially northern

people, to recognize their responsibilities and contributions to the rest of the world. Admitting that we are a biased group of people — biased because one of our reasons for being here is a special interest in or concern about the North — there was still far too much talk about how the rest of the country, or the rest of the world, affects our particular area, and too little about our responsibility to the rest of the country and the other parts of the world. This worries me, not only because of the lost opportunity to show that influence is a two-way street, but because such an attitude is bound to lead to an isolationist philosophy which in turn leads to a desire for special enclaves, protected from the rest of the world, with all of the vulnerabilities and weaknesses that go with such a situation.

A persistent example of our reluctance or inability to see northern issues or northern resources from the viewpoint of the rest of the world was the repeated exhortation, during the symposium, that Nature herself, and not some bureaucrat in some southern capital, should decide on what resources should be used, by whom and at what rate. By the characteristics and distribution of natural resources, so the argument was made, the pattern for economic and social development has been set, and one has only to follow the rules set by Nature, not by government, to achieve a harmonious and satisfactory economic and social development of northern regions. We heard this statement several times, made in different ways, in the past few days. I have no objection to these statements, for they make sense; however, I would point out that they cannot logically be used only for management of local resources by local people. For of all groups of people on the Earth who let the Earth itself decide the location and scope of their activities, it is the petroleum and mining people. These outside groups come into the North not because they like it, or because they were born there, but because there is a valuable resource there and they are in the business of finding and exploiting such resources, wherever they may occur. By the specific location of oil deposits in Prudhoe Bay or the Beaufort Sea, coal in Svalbard or iron at Kiruna, nature has set the conditions that lead to northern problems and opportunities, just as much as by the distribution of caribou or fish she has determined the distribution of northern settlements and the traditional life-styles of their inhabitants. One can't expect nature to set rules for one group of people and not the others.

All northerners, but particularly those in areas where there are resources useful to the south, have a responsibility to the rest of the world; and I am sorry that we did not use this symposium to explore that responsibility more thoroughly.

Good management will solve our problems

Another weakness of the symposium, it seems to me, has been the continued and perhaps uncritical statement of faith that management, whatever that is, either by traditional or scientific means, can be adequate and successful in both meeting social needs and preserving the natural resource base. In their specific topic areas, most groups tried to be realistic and identify limitations to what deliberate management could do — Dr. Mair's workshop being perhaps the outstanding example. But when we moved onto broader turf, we seemed to put undue faith in the ability of management :o enable us to have our cakes (or caribou) and eat them too. It seeemed to be taken as given that because there was now a plausible explanation for the population cycles in Greeenland caribou, or an understanding of harvesting principles for whales in the Chukchi Sea, or a comprehensive land-use plan for Finnish Lapland, that those natural resources are now reasonably safe from mismanagement. This attitude worries me, because it can lead to unrealistic expectations and then disillusionment, through which hard-won gains may be lost and well-intentioned policies may be discredited. Also, unquestioned faith in the effectiveness

of good management may lead to the power to make very big mistakes. As someone said, "the closer you come to playing God, the more careful you have to be not to steer the country toward Hell".

The North as a welfare area

A shortcoming we couldn't seem to get rid of was the assumption of a welfare syndrome for the North. Through our deliberations and recommendations there seems to run a plea for support, a call for protection or special treatment, as if the North is not and perhaps never will be strong enough to stand on its own feet and be treated as a productive equal. In part, this is probably because of the real vulnerability of the North to change; in part it is because of its past economic and policy dependence; and in part it may be because of the self-centeredness of northerners and their reluctance to consider their responsibilities to the rest of the country and the world. But whatever the causes, the continued assumption of a welfare syndrome is not healthy. There are exceptions, of course; and one of the strengths of this symposium has been the participation of a sprinkling of sophisticated and self-confident northerners who have no intention of being dependent on anybody. But at this meeting, as at so many others, the welfare-pleaders did most of the talking.

The plea for support or charity was not used only for support as a whole. It was especially evident when we discussed the need for science. How many times during the past three days did we hear that the government ought to support more science? Certainly I heard that plea a lot more often than I heard *why* it should support increased science, or what could be the benefits if it did and the bad consequences if it did not. I am not one to purpose that the support of science should be strictly utilitarian, or that all science should have an identifiable tangible pay-back; but I do think that we can do better than plead science as a welfare case. The same is true of science establishments; our discussions of the needs and problems of the Naval Arctic Research Laboratory at Barrow or the Inuvik Research laboratory were not, to my mind, of the kind that would enhance the prestige of Arctic science.

Management of common property

Considering the recommendations presented by our workshops, and thinking back to the many other meetings that have been held about similar problems in the North, I have been wondering if the symposium as a whole, or any interest group here, has shown evidence of any real increase in the skills of relating resource management problems, as seen from the point of view of the resources, to a situation where there are many dispersed and individual decision-makers. Yet it is the ability to build this relationship that is central to the wise management of renewable resources. Dr. Usher drew attention to this problem in his paper on the first day. Despite the growing number of problems and experience in dealing with them, and despite the rapidly increasing amount of information on all sides, I'm not sure that any interest group, — Native, local or distant governmental, or southern industrial, — has really shown an increase in its ability to manage common resources in the face of conflicting opinions and multiple jurisdictions. Many individual decisions, good in themselves, only increase management problems and complexity. This, of course, is a problem which is not confined to the North; but in the North we have it badly.

Take the management of a caribou herd in northern Canada, for example. A large part of the information on the herd population and condition of the range, and some of the research on diseases and parasites, comes from the Federal government; the basic re-

sponsibility for management policy, and statistics on harvesting, etc., lies with the Territorial government; most of the detailed knowledge of behaviour, and the control of local use of the herd, lies with local Hunters and Trappers Associations, but there are distortions where sporting or tourist activity is important; and the ultimate decision-maker about what happens to any particular caribou is the individual hunter who has his own set of rights guaranteed by law and custom. How to manage, in the interests of both the caribou and the individual hunter, in such a situation? All northern countries have similar kinds of problems. Symposia like this, and government planners, are apt to propose institutional changes, which experience has shown are just as likely to add to the complexity as reduce it. It is my feeling that whatever changes are made in the rules or the rights of anyone, the success in managing resources in such cases is an art, not an impersonal system, and good results depend upon consciously developing the skills and sensitivies to practice the art of sustained and profitable care of a common-property resource.

Because we have not consciously endorsed the idea that we need to develop management skills, but have talked more about rights and management responsibility or rules, we have seen here, as elsewhere, an entrenching of positions and management techniques that I suspect are already out-of-date in a rapidly changing situation. This is a real problem with symposia — we tend to invite people who have clear opinions or who have shown in the past that they have something to say, only to find that when they get here, what they have to say is partly irrelevant because of the rapidly changing situation on all sides. Your present speaker may be very much a case in point.

Was the symposium format right?

It seems to me that the symposium was good for people who have a southern-trained logic flow and an analytical approach to problems. It was not good for those who wanted to use it as a means of finding what was really going on in areas of specific concern to them. The workshop topics and format were excellent for those taking a western scientific approach; it was not adequate as a forum to stress interplay between issues or deal with subtleties. The main problem with the structure and schedule was that it did not give sufficient encouragement to those who were not accustomed to presenting their ideas in an argumentative or explanatory way. We still expected the northerners to play the word-games of the southerners. I don't know whether it would be possible to have a better format to deal with such a topic in four days.

Were the right people here?

There were several complaints that there were too few senior decision-makers present. I think that the symposium did very well; — we have had a member of Parliament and an ex-Minister taking full part, and a good range of "users" and "doers", as well as "studiers". We should not forget that this has been basically a MAB meeting, thus part of an international program of research and training; it was not a public meeting on northern policy or a platform for lobbies.

Did the symposium serve MAB? Did UNESCO get its money's worth?

There is no doubt that some of the workshop reports are directly in line with MAB objectives, and will become useful scientific and planning documents in their own right. Some of the recommendations call directly for MAB follow-up; others, if followed up on their own, could well become or be fitted into MAB activities. You have already heard

that the Canadian Committee for MAB has taken responsibility and promised some action. All of this means, I think, that MAB and UNESCO can feel that, from their point of view, this symposium was successful.

On the other hand some critical MAB areas were not satisfactorily dealt with. We did not, it seems to me, build up a case for increased government or policy attention, and funding, to the problems of renewable resources and the economy of the North. To show the need for and advantages of knowledgeable policy attention is an important MAB concern. We did not, I think, satisfactorily marry *community concerns*, *science*, and *government responsibility* in the area of our discussions. And that is the central objective of the Man and the Biosphere Program. And we hardly touched at all on the whole area of training or improving the ability of local people to deal with the social, environmental and resource problems of the future, rather than of the present. That, too, is a very important element of MAB.

Clearly, our work is not finished. And MAB is not finished with renewable resources and the economy of the North.

APPENDICES

Ethical Principles for the Conduct of Research in the North

Association of Canadian Universities for Northern Studies
Draft Document 1981 (based upon Canada Man and Biosphere Discussion Document, 1977)

Introduction

In too many cases, researchers have worked in isolated communities without regard for the people who live there. Communities have been disrupted, and essential local resources used without consultation. Privacy is difficult in small communities, creating additional problems for participants. Guidelines, or principles, are needed so that research may be carried on with a minimum of friction and social disruption.

The principles proposed here are intended to promote co-operation and mutual respect between researchers and the people of the North.

Northerners are involved with research in several different ways:

1. As research subjects,
2. Providing information,
3. As part of a research team,
4. Using the completed research, and
5. Identifying research needs.

If research is to be explained clearly, conducted ethically, and used constructively, it must be guided by principles that consider all of the above mentioned ways in which Northerners are likely to be involved in research activities.

Principles

1. The research must respect the privacy and dignity of the people.

2. The research should take into account the knowledge and experience of the people.

3. The research should respect the language, traditions and standards of the community.

4. The person in charge of the research is accountable for all decisions on the project, including the decisions of subordinates.

5. No research should begin before being fully explained to those who might be affected.

6. No research should begin without the consent of those who might be affected.

7. In seeking informed consent, researchers should clearly identify sponsors, purposes of the research, sources of financial support, and investigators responsible for the research.

8. In seeking informed consent, researchers should explain the potential effects of the research on the community and the environment.

9. Informed consent should be obtained from each participant in research, as well as from the community at large.

10. Participants should be fully informed of any data gathering techniques to be used (tape and video recordings, photos, physiological measures, etc), and the use to which they will be put.

11. No undue pressure should be applied to get consent for participation in a research project.

12. Research subjects should remain anonymous unless they have agreed to be identified; if anonymity cannot be guaranteed, the subject must be informed of the possible consequences of this before becoming involved in the research.

13. If, during the research, the community decides that the research may be unacceptable to the community, the researcher and the sponsor should suspend the study.

14. On-going explanations of research objectives, methods, findings and their interpretation should be made available to the community, with the opportunity for the people to comment before publication; summaries should also be made available in the local language.

15. Subject to requirements for anonymity, descriptions of the data should be left on file in the communities from which it was gathered, along with descriptions of the methods used and the place of data storage.

16. All research reports should be sent to the communities involved.

17. All research publications should refer to informed consent and community participation.

18. Subject to requirements for anonymity, publications should give appropriate credit to everyone who contributes to the research.

Definitions

The principles refer to research in its broadest sense, including fundamental or applied research in the physical, biological or social sciences. Surveys or monitoring studies would also be included. In general, "research" includes all technological activities in the North. Even mineral and petroleum exploration surveys would be expected to honour the general principles. However, the more detailed principles on informed consent and reporting of research results are meant specifically for researchers and might not apply to all technological activities.

The principles focus on those aspects of science that affect local people, communities and their environment. Even where research does not involve the local people in an obvious way, it may still have effects on the land, water or wildlife of the region, and may thus affect the people indirectly.

The word "community" is not restricted to the area of a settlement. The surrounding land that supplies resources for the settlement, and the people who live on the surrounding land, are viewed as part of the community.

The geographic area of concern includes Yukon Territory, the Northwest Territories, Nouveau-Québec, Labrador and the northern parts of the provinces from Ontario to British Columbia (the Extreme North, Far North and Middle North as defined by Louis-Edmond Hamelin [1975]). Although the emphasis is on isolated northern communities, the general principles are not unique to the North and most of them could be applied elsewhere.

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